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DRUG USE AND HIGHWAY SAFETY: A REVIEW OF THE LITERATURE

University of Wisconsin
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16. Abstract This report reviews the research literature concerning several aspects of drug use as it relates to traffic safety. Some of the topics covered include the effects of drugs, types of drug users; research problems in assessing risk; laboratory findings concerning the effects of drugs; survey findings, toxicological investigations; and a discussion of the legal aspects of drug-driving laws.			
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PREFACE

The purpose of this report is to provide a comprehensive review of the literature concerning various aspects of the relationship between drug use/abuse and traffic safety. Although intended primarily as a research review, very basic information concerning drug abuse is also included. This was done so that the report could be of maximum usefulness to the general public as well as to researchers in this area.

It should be pointed out that a review of this type could be intended to include only the most "valid" studies in the area of drugs and driving or it could be intended to include all the available studies in this area. If "valid" were taken to mean only those studies where adequate controls, random selection and comprehensive screening procedures were employed, a critical drug-driving review, at this time, would be brief to the point of non-existence.

In the preparation of this report, an attempt was made to include any study which has received some publicity via traffic safety periodicals, circulated research reports or, in some cases, through the news media. This was especially the case with regard to systematic analytical studies of fatal crash victims and of driver record surveys. It can safely be stated that all such investigations have suffered from a number of inherent methodological deficiencies. In many cases, comments are offered concerning such deficiencies and, in cases where pertinent information was not available to the reviewer, statements to this effect are also apparent.

In compiling the report, several previous reviews regarding various aspects of the drug-driving relationship were found to be of great assistance. Of special importance were the reviews by Waller (88) concerning

research problems and methodologies and by Kibrick and Smart (35) concerning drug use and driving risk. Acknowledgement is also due to Dr. E. Polacsek and the documentation department of the Addiction Research Foundation (A.R.F.) in Toronto, Canada for their assistance in obtaining reprints as well as for their fine annotated bibliography series.

Various U.S. governmental agencies also supplied much information concerning drug use and abuse in general. These agencies include: the Bureau of Narcotics and Dangerous Drugs (BNDD); the National Institutes of Mental Health (NIMH); and the U.S. Public Health Service. In addition to these sources, the information contained in appendix D was provided by the National Committee on Uniform Traffic Laws and Ordinances.

Finally, appreciation is offered to Miss Mary Forell for her assistance in preparing the first draft; to Mrs. Jane Burroughs and Mrs. Sue Roebenalt for their efforts in typing the final draft and to Miss Sandra Ulrich for her invaluable assistance in organizing and preparing the final draft.

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SUMMARY

A review of the research literature failed to confirm suggestions that drug use, other than alcohol is causing a large percentage of highway crashes. Systematic chemical analyses conducted on fatal crash populations have failed to reveal a disproportionate involvement in such crashes by drug users. Further, no investigation, of any type, has demonstrated a disproportionate contribution to crashes or violations by drug use per se.

While analytical studies have been fragmentary in the types of drugs investigated (primarily prescription drugs), they have indicated that the prevalence of such drugs in fatal crashes is not as great as would be expected on the basis of the estimated twelve to twenty percent of drivers who frequently use such drugs. Driver record surveys, while revealing higher violation rates and probably higher crash rates for drug users, have indicated that the poor records of drug users are usually evident before they began using drugs and that other factors, such as social and personality problems, may be the primary causal factors leading to such poor records.

The primary drugs of concern to highway safety are: 1) the prescription psychotropes, 2) the hallucinogens and 3) narcotics. At this point in time, prescription psychotropes are the only drugs which have been investigated to any reasonable degree. It appears, however, that these drugs, primarily the amphetamines, may be accounting for the greatest drug contribution (other than alcohol) to highway crashes.

In spite of the problems involved in drug research and the inadequacies in the research conducted to date, it is evident that alcohol is having a much greater impact on highway crashes than are other drugs. Also, it is apparent that approximately half of the drug abusers, which were investigated, were

also excessive users of alcohol.

It was suggested that future research in this area be conducted in conjunction with ongoing Alcohol Safety Action Programs and that additional legal action, at this time, would appear to be premature.

CHAPTER 1. DRUG USE IN THE AMERICAN CULTURE

Introduction

There has been a considerable degree of concern, recently, that the use of mind altering drugs other than alcohol may be making a substantial contribution to the nation's traffic problems. This concern has arisen primarily from the highly publicized increase in drug use among the nation's youth. Well-meaning and conscientious as it may be, much of the speculation directed to the drug-driving problem has not been based on available data. In fact, much of the concern for "drug abuse" in general has been based on emotionalism, misinformation, and over-reaction. On the other hand, it should be pointed out that much of the argument that drug use does not constitute a major problem has also been based on emotionalized opinions rather than objective points of view. It is because of the prevalence of distorted viewpoints, that a chapter will be devoted to a discussion of what constitutes a drug, which drugs should be of primary concern, and who the major "offenders" of the various categories of potentially dangerous drugs are.

What is a drug?

Pharmacologically, a drug is any chemical substance which causes a change in the function and/or structure of living organisms. Admittedly, this definition is quite broad, and that proposed by Neil (55) may be more suitable for present purposes. Neil defines a drug as, "any substance administered to a person by a physician or by the patient himself in hopes of achieving a better physiological state." To this we might add the hopes of achieving a better psychological state as well. Still, such a definition covers a wide variety of substances ranging from aspirin, NoDoz, alcohol, caffeine and tobacco to the more potent, mind altering hallucinogens and narcotics. The important

thing to remember, however, is that "excessive" use of any of these drugs could be expected to have adverse reactions on the human body. In addition, because society condones the use of many of the more common drugs on the market, the adverse reactions associated with many of these drugs are often overlooked. In fact, limited research has indicated that some of the more commonly accepted prescription drugs (used legally or illegally) may be having more of an impact on traffic crashes than are some of the more highly publicized illegal drugs. Any conclusion to this effect, however, would have to be tentative, as it would be based on fragmentary research findings, and as adequate tests have not been available for detecting the presence of drugs such as the hallucinogens in crash victims.

What is Drug Abuse?

Drug abuse is a controversial and ambiguous term. From a societal point of view, drug abuse could be defined as the use of any drug for "other than legal therapeutic purposes". Such "other than legal therapeutic purposes" would include a variety of motivations such as a desire to withdraw from life's problems, to escape boredom, to seek a euphoric high, or perhaps to rebel from society's many restrictions. From a traffic safety point of view, however, it makes little difference whether a drug use is therapeutic or non-therapeutic, or whether it is legal or illegal. Rather, the important factor is whether such use deteriorates the skills and judgement required for safe driving to such a point that the user presents a greater crash risk to the highway situation.

In many instances, such "abuse" may constitute nothing more than "excessive" use of the drug in question, while in others, any use at all may constitute a hazard to driving. Certainly, there will be many individual differences in what constitutes "excessive" drug use. In fact, there is no easy way to

define what excessive use is, except in specific situations where performance criteria may be measured. Even then it is difficult to quantitatively relate impaired performance with crash risk.

Also notable, is the fact that in the past many have considered drug "abuse" only as associated with crime, the underworld, and "addiction". The latter term itself is controversial and neither drug "abuse" nor drug "addiction" need be limited only to the use of narcotic drugs such as opium and heroin. In this review, drug "abuse" will be used to refer to the use of any drug which results in impaired driving performance or increased crash risk. It is fully realized that the criteria for determining such "abuse" are less than perfect.

What is Addiction?

"Addiction" is a term which has been used to refer to the fact that users of a narcotic become "hooked" on the drug in that they are powerless to discontinue its use. Implicit in this idea of "addiction" is the fact that after prolonged use of a narcotic drug, a continually increasing dosage is required to produce the same drug effects (increased tolerance to the drug), and discontinued use results in violent physical withdrawal symptoms as the body becomes dependent upon the drug for "normal" functioning.

Recently, however, it has become apparent that many drugs are capable of producing various degrees of tolerance buildup or physiological withdrawal symptoms, or both. In addition, it has become evident that drug use may be perpetuated for psychological reasons such as the tendency to seek the pleasure of a drug "high", and/or to avoid the displeasure associated with discontinued use of the drug or "coming down". Other pertinent psychological aspects of drug use include the association of drug use with one's peers and friends; a desire to escape from unpleasant environmental or situational conditions; and

finally what is commonly referred to as "habit".

Thus, researchers in the area of drug use have preferred to replace the term drug addiction with the term drug dependence. Further, it has been realized that drug dependence may be of two forms -- physiological dependence and psychological dependence. Physiological dependence refers to changes in normal physiological functioning resulting from drug use (e.g. the tolerance build-up to a particular drug and/or the withdrawal symptoms associated with discontinued use). Psychological dependence, on the other hand, refers to the expectancies of pleasure associated with a drug "high" and the displeasure associated with "coming down", as well as the environmental and habit forming aspects of drug use.

In the past, many have associated the dangers of drug use with only the physiological aspects of dependence. However, one need only to observe the frustrations of the many persons who attempt to break the cigarette smoking habit in order to gain the full significance of the power of psychological dependence.

Which Drugs Should be Investigated Relative to Driving?

Because any drug can be harmful to the human body when used in excess, many drugs could provide hazards to the traffic situation. Thus, a society which has produced pills to alleviate many of the problems of its constituents should develop a new respect for all drugs. This is sometimes difficult since drugs which affect the mind may have subtle or obvious side effects. While some of these effects may be immediate, others may become evident only after prolonged use.

However, there are certain drugs which have revealed more potential than others for deteriorating the motor skills and judgements required for driving. Such drugs are not limited to the narcotics and other illegal drugs. Five major

categories are listed below which either have received or should receive research attention. Included in this population of drugs are:

I. Legal Drugs

- (1) drugs sold "over-the-counter" or without a prescription (i.e., alcohol, caffeine, nicotine, aspirin, cough syrup, etc.)
- (2) drugs sold by prescription for therapeutic uses only (i.e., sedatives, tranquilizers, stimulants, antihistamines, etc.)

II. Illegal Drugs

- (1) prescription drugs sold "under-the-counter" or in illegal channels (same as legal prescription drugs except for source)
- (2) hallucinogens (i.e., marihuana, LSD, mescaline, STP, etc.)
- (3) narcotics (i.e., codeine, morphine, heroin, etc.)

In the non-prescriptive or "over-the-counter" category particular emphasis should be placed upon the use of alcoholic beverages. However, tobacco (nicotine), cough syrups, coffee (caffeine) and various other "lesser" drugs have in some cases been demonstrated to have adverse effects on driving related activities (1, 2, 41, 44, 46, 53, 65, 57).

In the prescription category, whether legal or illegal, primary concern is appropriate for three major types of drugs. These drugs include: (1) sedatives and hypnotics of both barbiturate and non-barbiturate types; (2) tranquilizers or ataraxics of both the major and minor variety; and (3) stimulants, primarily of the amphetamine type. Other drugs which have been investigated include antihistamines, antidiabetics, anticonvulsants, anticoagulants, anti-infectives and motion sickness preparations. Those which have demonstrated mind-altering properties are termed psychotropes.

In addition, marihuana and the more potent hallucinogens such as LSD, mescaline, peyote, STP, and DMT may present a problem to highway safety. The word

may is used since there are no indications concerning the frequency with which such drugs are used in conjunction with driving, or are factors in highway crashes. Certainly the effects of these drugs would be expected to deteriorate driving ability.

Finally, narcotics of the opiate type (heroin, morphine, etc.) as well as synthetics such as methadone are being investigated with regard to their import to highway safety.

Major Users of the Various Categories of Drugs

Prescription and non-prescription drugs have long been used by the adult population of Americans. Adult American women are especially prone to the use of stimulants (in the form of diet pills), tranquilizers and sedatives. Adult males also appear to use a considerable but lesser amount of central nervous system stimulants (in the form of pep pills) and depressants (47, 62). While it has generally been thought that most of such users would fall into the "legal" prescription category, it has become quite evident that the use of many of these drugs is far more than therapeutic reasons would justify. In addition, these same drugs are becoming used more frequently by younger people who obtain them primarily through illegal channels. (It has been estimated by the U.S. Food and Drug Administration that half the manufactured stimulant and depressive psychotropes go into illegal channels). Among the younger users, unlike the adult population, males appear to be the heaviest users of both stimulants and depressants (62).

Illegal hallucinogens, although probably used by more adults than is commonly supposed, are still primarily the domain of the younger "under 30" generation. Such drugs are used by a variety of different groups including college and high school students, men in the military service, and other groups, the totality of which engulfs virtually all of the socioeconomic classes.

Narcotics, primarily of opiate derivation (opium, morphine, and heroin) have long been thought to be primarily a ghetto problem. Although the predominate usage is still primarily in these low socioeconomic areas there is considerable evidence that the use of "hard" narcotics is spreading to the middle classes, especially among the young constituents of such classes. Deaths as a direct result of heroin overdosage have been reported among children as young as eight years of age. Official estimates indicate that there are more than 65,000 addicts in the United States; most of whom are located in the immediate New York City area. This estimate is probably quite conservative.

Who are the Major Drug Users?

General Categories (not necessarily associated with driving)

The Bureau of Narcotics and Dangerous Drugs (BNDD) (6) has suggested a drug user classification system which includes the following groups:

(1) Situation Users: This group of users employs drugs for a specific functional purpose and may include students cramming for exams, truck drivers or salesmen attempting to make up for lost trip time, housewives who use drugs to keep their weight down or give them extra energy, and athletes who may wish to obtain their ultimate energy level. It appears that the majority of such users are users of amphetamines and/or other stimulants.

(2) Spree Users: Usually of high school or college age, students may use drugs for "kicks" or out of curiosity alone. There is some evidence of a high degree of peer influence in this type of use (38, 62) and the drugs most commonly involved are the stimulants depressants, and hallucinogens.

(3) "Hard-core" Addict: This type of user, formerly confined primarily to the ghetto, is now present in a variety of socioeconomic classes. Nearly all of this person's activities revolve around the drug experience and securing supplies. There is both strong psychological and physiological dependence in

this type of drug use. "Addicts" are not necessarily limited to the opiate users but may be considered as such among sedative and stimulant users as well.

(4) "Hippies": While loosely defined with regard to any particular criteria, so called hippy cultures most frequently involve extensive drug use. These drug users tend to distrust the societal systems of today and believe that a new way of life should be found. Drugs are an integral part of this life for many members of this culture and many of these users could be ascribed to the "hard-core" category as well. A major difference, however, is that while the "hard-core" users are still primarily from the lower socioeconomic classes; the hippy cult is primarily a product of middle and upper income origin and the educational level of this group is generally much higher than among the "hard-core" users.

The BNDD classification further indicates that drug dependence is not discriminating and that four key factors are involved in its development: (1) the drug; (2) the individual; (3) the environment; and (4) a personality which predisposes the individual to such activity. (While most laws concerning drug abuse have sought to control either the drug or its user, it would appear that the latter two factors are more formidable and have been neglected to a considerable degree.)

Categories of Drivers

Waller (86) has suggested a classification system which pertains primarily to drug-using drivers. He suggests that there are three primary groups which use drugs and drive as well. These groups include:

(1) Sociopathic Drug Users: Such persons are generally convicted drug users and tend to "run the entire gamut of antisocial acts including assault, sex offenses, theft, forgery, misuse of alcohol, and vandalism."

These people have high traffic and criminal violation rates, but relatively

low crash rates, according to Waller. He suggests that the high violation rates are the result of a lack of development of a super-ego or conscience and that such people may actually seek to keep themselves under police surveillance. Most of such drivers may be at somewhat higher risk of highway injury for reasons other than impairment by drugs. Some, such as those who frequently use amphetamines, may also be at greater risk because of the use of drugs. However, the majority of these drug users have been known to authorities before they began using drugs. Waller's suggestion of increased risk on the part of amphetamine users was based on research carried out in Canada (69).

(2) Teenage and College Students: Waller suggests that among the mind-altering drugs other than alcohol and tobacco, this group generally tends to use marihuana only. In comparison with alcohol and tobacco, however, school surveys have indicated a high rate of alcohol and tobacco use followed by much less frequent use of marihuana, amphetamines, barbiturates and tranquilizers. Still, although most frequent users of drugs use a variety of drugs, the majority of this group appear to be the occasional or curiosity type. This category would compare most closely with the BNDD "spree user" category.

(3) Alcoholics: Drivers, whose treatment -- whether prescribed or self-directed -- includes the use of psychoactive drugs, comprise the third and most dangerous group according to Waller. With regard to a California study of fatal single vehicle crashes, he points out that two-thirds of the fatalities in which barbiturates were found, also had alcohol in their blood. Over one-half of such persons had blood alcohol concentrations of 100 mg. % or higher. Waller suggests that in most of these cases the impairment was primarily a function of the excess alcohol although it is possible that synergistic relations were responsible for some of such crashes.*

* See page 20 for explanation of a "synergistic" reaction.

In summary, Waller suggests that most persons, "who use prescription and non-prescription drugs to cope with every day stresses and life, and most teenagers and young adults who use marihuana only," probably do not present any increased risk of crashes or citations.

There have been suggestions from some researchers that excessive drug use, as well as many of the problems associated with it, derive primarily from a personality problem in the first place. It has never been determined in which cases personal problems precipitate the drug use and/or in which cases the drug use precipitated the personality and other adjustment problems. However, most researchers have found that when sample populations of drug users are compared with those of non-users, the former groups exhibit significantly more personality abnormalities than do the latter groups. (62, 68) The same situation has proved to be the case in epidemiological studies conducted in drug using cultures such as India and North Africa. However, such studies have also been unable to resolve whether observed differences are the result of drug use or of the difference in environmental backgrounds of the groups compared.

It does appear, however, that persons who are frequent users of alcohol are similar to those who are excessive users of other mind-altering drugs in that they have certain personality predispositions and characteristics which differentiate them from non-users. A Toronto study of high school students (referred to in 62) indicated that drug users generally had lower grades, significantly greater absenteeism rates and came more frequently from families in which the parents used both alcohol and tobacco. The investigators suggested modelling behavior, as well as peer influence as possible reasons for drug use. Support for the suggestions concerning personality disorders has been provided by several studies involving solvent sniffers, marihuana users,

and LSD users (62). These investigations have consistently found a higher frequency of personality disorders among drug users than among drug abstainers. Generally, the predominance of such disorders has been found to be correlated with frequency of use.

Appendix A provides the reader with a glossary of some more commonly used terms among drug users.

CHAPTER 2. THE EFFECTS OF DRUGS ON THE HUMAN BODY

Alcohol and Other Drugs

Up to this point alcohol has been treated as any other drug. This has purposely been done in order to emphasize that alcohol is a drug. If this is kept in mind then the proper perspective can be given to the relative impact on traffic crashes and violations which other drugs may be having. Furthermore, there is a vast body of data demonstrating that alcohol acts as a depressant at all concentrations in the blood, including very low ones.

There is sufficient evidence to assert that alcohol is the single greatest human factor involved in fatal traffic crashes. Alcohol contributes to at least half of the traffic fatalities and in most of such crashes the responsible driver (or pedestrian) can be considered legally "drunk" (100 mg. % or higher).

While many articles dealing with drug abuse have suggested that marihuana is the most frequently used drug among young people, research surveys have consistently shown that alcohol is the most frequently abused drug with marihuana, stimulants and tranquilizers running far behind (62). The reason for this apparent inconsistency is that many opponents of "drug abuse" do not consider alcohol as a drug in the same sense as other psychoactive drugs. However, it is the contention of this review that alcohol should be considered as such. Certainly within the realm of traffic safety, it is evident that alcohol is the most "dangerous" drug with regard to its contribution to traffic deaths.

It has also been suggested that tobacco smoking may have more of an impact in crashes than has formerly been suspected due to a deterioration of visual functions by carbon monoxide and/or nicotine itself (44, 46, 47). This aspect may be of particular importance with regard to night driving (65). However, there have been some investigations which have contradicted this point (31, 80).

Since much has already been written with regard to the problem of alcohol and traffic crashes, the remainder of this review will be concerned with drugs other than alcohol (except when interaction effects are discussed). Consequently, the term "drugs" will heretofore refer to drugs other than alcohol unless otherwise specified.

Reviews Concerning Drugs and Driving

In recent years there have been many articles written about the effects which drugs may be having on automobile crashes. Generally, magazine and newspaper articles have suffered from a lack of information and have relied primarily upon anecdotal reports, when available, and more often upon pure speculation. Some articles have even gone so far as to suggest that fatal single vehicle accidents wherein no signs of alcohol, barbiturates, or amphetamines can be found and no other cause can be determined for the accident, may be caused by the use of hallucinogens -- as no tests are available for the detection of these drugs in the human body.

On the other hand, research reviews have generally concluded that the use of drugs does not appear to be making a disproportionate impact upon crashes -- fatal or non-fatal. Although the latter conclusions are based on less than complete evidence, they do offer a more constructive approach to the problem than does reactive speculation.

Specific Effects of Various Drugs

Many of the articles concerning the impact of drugs on highway crashes have resulted from known physiological effects of such drugs. For this reason it would be advantageous to review the effects of some of the more "potent" drugs at this time.

Sedatives and Hypnotics

The effects of barbiturates on human functioning are in many ways similar to those of alcohol, as both act as central nervous system depressants. Barbiturates, in commonly used therapeutic doses, mildly depress the action of the nerves, skeletal muscles, and the heart muscle. They slow down the heart rate and breathing, and lower the blood pressure...

"But in higher doses, the effects resemble drunkenness: confusion, slurred speech, and staggering. The ability to think, to concentrate, and to work is impaired, and emotional control is weakened. Users may become irritable, angry and combative. Finally, they may fall into deep sleep." (83)

Thus the symptoms associated with barbiturate usage resemble those associated with the use of alcohol, especially at high dosage levels. At low dosage levels there is an initial relaxation and release of inhibitions, followed by a progressive deterioration of motor performance at higher dosage levels, and finally extreme depression to the point of sleep, unconsciousness, or even death at very high dosage levels. Most of such characteristics would logically be expected to deteriorate the skills and judgement required for the safe operation of a motor vehicle.

With regard to dependence upon such drugs, the use of barbiturates can result in both physical and psychological dependence in the strictest sense of the terms. Prolonged use of these substances results in both a tolerance build-up to the drug and to a need for continued use of the drug for "normal" physiological functioning. In fact, some medical experts consider barbiturate withdrawal symptoms as more dangerous and more difficult to overcome than those resulting from narcotic dependence. Non-barbiturate sedatives have similar effects.

Tranquilizers

Ideally, tranquilizers are prescribed only to calm and/or relax the patient and to diminish anxiety. Unfortunately, many of the major and minor tranquilizers also cause drowsiness, especially in the initial stages of use when the body has not yet stabilized in its reactions to the drug. During this initial stabilization period, the danger of such drugs is particularly enhanced due to the unpredictability of effects.

It should also be pointed out that under some circumstances, the use of tranquilizers in therapeutic doses could be expected to improve driving skills and judgement. Certainly if a person is hyper-excitabile or extremely anxious and the prescribed use of tranquilizers eliminates these undesirable conditions, said person would be expected to be a more capable driver with, rather than without, the drug. On the other hand, undesirable side effects such as drowsiness must be taken into consideration, and excessive dosages of such drugs should be avoided.

Antihistamines, motion sickness drugs, antidepressants, and other "minor" drugs have similar side effects during the initial stabilization period.

Stimulants

Stimulants such as the amphetamines (diet pills, pep pills, "bennies," "dexies," "speed") act by stimulating the central nervous system. The effects of these drugs include: increased heart rate and blood pressure; dilation of the pupils; and concomitant subjective feelings of alertness, self-confidence and well-being. Other side effects may include dry mouth, sweating, headache, pallor, depression of appetite and talkativeness.

Prolonged use reverses many of the desirable effects as the user may become tense, irritable, and aggressive. Other symptoms of prolonged use include inability to concentrate, hallucinations, dulled emotions, and a false

sense of competence.

One of the most undesirable effects of amphetamine use with regard to driving behavior is the extreme fatigue and mental depression which occurs when the effects of such drugs have worn off. This depression may come without warning after extended use.

The development of a high tolerance level is characteristic of the body's adaptation to amphetamines. Although the withdrawal syndrome is not the same as that for narcotics, withdrawal symptoms have been observed when high usage is discontinued. Thus amphetamines are considered by some authorities as capable of producing both physical and psychological dependence.

Again, as was the case with tranquilizers, it is certainly plausible that in some cases the use of amphetamines results in beneficial effects to the driver. In some situations where fatigue is present and a rest stop is impractical, the use of amphetamines may even increase the safety factor. It would appear that prolonged and/or excessive use of such drugs represents the most serious danger to the highway situation. This, again, constitutes drug abuse rather than drug use. Unfortunately, it is difficult to determine where drug use ends and drug abuse begins. For the most part, this distinction has been based on whether the drug has been legally prescribed or not. Certainly, there are inadequacies involved in making a distinction on the basis of this criterion.

Marihuana

In some ways the physical characteristics resulting from the use of marihuana are similar to those precipitated by the amphetamines. The use of either drug results in elevated blood pressure and heart rate, lowered body temperature, as well as a dryness of mouth. Formerly it was believed that marihuana smoking also resulted in dilation of the pupils; however, recent research has

indicated that this may not be the case (91). Unlike the amphetamines which generally suppress hunger, marihuana appears to stimulate hunger and often results in drowsiness and ultimate deep sleep after which few apparent after-effects are evident.

Subjective symptoms of marihuana users which are of particular concern to driving behavior include reported distortions of space and time, a feeling of well-being or euphoria, and possible hallucinations from high dosages, prolonged use, or a high content of the active ingredient THC (tetrahydrocannabinol).

While many descriptions of the subjective effects of marihuana have suggested an inability to concentrate, it would perhaps be more accurate to describe concentration as intense, but narrow in scope. Objects or events within the central visual field receive much attention to the exclusion of objects or events in the peripheral area. As a result the user may have less control over his concentration. Claims of an increase in aggressive tendencies have not been scientifically supported.

It should also be pointed out that there are several grades of marihuana ranging from low THC content "bhang" to high THC content "charas" or "hashish." Availability in the United States is limited primarily to the lower grades.

There has been no evidence to support any type of physical dependence or increased tolerance associated with the use of marihuana.

Other Hallucinogens

Physical effects of the more potent hallucinogens, such as LSD, mescaline, STP, peyote, etc. are similar but much more intense than those associated with marihuana. Such reactions may include lowered body temperature, rapid heart beat, profuse perspiration, nausea and dilation of the pupils.

Subjective reactions include frequent hallucinations, loss of depth and time relationships and distortions in size, movement, color and spatial arrangements. The ability to make sensible judgements and to see common dangers is deteriorated and distorted, hence making the user unable to adequately perform the judgements or skills required for the safe operation of a motor vehicle. Unlike the marihuana smoker, who may feel that his driving abilities are enhanced by the drug, users of the stronger hallucinogens may realize their inability to safely operate a motor vehicle. It is not known how frequently or under what conditions the operation of a motor vehicle is attempted under the influence of hallucinogens. However, it is suspected that the frequency of combining the two situations is much less than is the case with the use of alcohol in conjunction with driving. Finally, there is no evidence of physical dependence associated with any of the hallucinogens.

Narcotics

Narcotics are similar to barbiturates in that they are central nervous system depressants. They also produce a marked reduction in sensitivity to pain, create drowsiness, induce sleep, and reduce physical activity. Perhaps the most detrimental effect due to the use of these drugs is the extreme physiological dependence which is developed. Withdrawal symptoms may include breaking out in a cold sweat, nausea, vomiting, and possible convulsions. The possibility of such symptoms occurring while a user is operating a vehicle should pose a danger to himself and other users of the roadway.

It has formerly been thought that "addicts" do not present a significant hazard to highway crashes since most of this population do not have access to automobiles. This still appears to be the case although the use of narcotics has expanded beyond the ghetto.

An important point to be made here is that the use of stimulants such as the amphetamines increases the user's level of activity (and the likelihood of driving) while the use of barbiturates, narcotics, and possible hallucinogens decreases overt activity (thus making driving less likely).

Summary

From the foregoing descriptions it is apparent that many of the effects of the various drugs could present serious problems if such effects should occur in a user while he is operating a motor vehicle. It is because of the knowledge of these various effects that articles have been written concerning the impact which drugs are having on traffic crashes. It is not enough, however, to show what effects drugs can have on a user in order to generalize that such users are causing traffic crashes and fatalities. Waller (87), for example, has pointed out that California law imposes restrictions upon the possessors or users of illegal drugs because of the presumption that such persons present an increased accident risk. He also points out that when this presumption was tested, it proved to be wrong.

Also, with the exception of hallucinogens and narcotics, Neil (55) has indicated that most drugs are administered with the intention of improving one's physical and mental state. (It has already been suggested that in some cases a person may be a better driver with a drug than without.) Neil goes on further to state that no statistics are available which indicate that drugs are having an impact on the overall accident rate. Until such information is available, he contends that legislative remedial action is not indicated.

Forney and Hughes (25) have also emphasized that most drugs are designed to produce desirable changes in the individual. They are created for the promotion and maintenance of human well-being. Nevertheless, the literature on drugs and driving concentrates on the potential hazard of such substances

because they have possible detrimental effects on physical and mental functions.

In most cases, as has been indicated, it is not drug use per se which causes adverse reactions in the individual. Rather, it is the abuse or over-use of the drug in question. This in turn puts much emphasis on the type of individual who misuses the drug in the first place. We do not know, in fact, how many people combine the misuse of drugs with driving or how frequently they might do so.

The Interaction of Alcohol with Other Drugs

In addition to the various effects associated with specific drugs, many persons at least occasionally use alcohol with other drugs, the interaction of such drugs with alcohol produces a whole new dimension of possible side effects, adding to the complexity of drug-driving research. Also, since alcohol and other drugs remain in the blood stream for relatively longer periods of time than most users realize, the occurrence of such interaction effects may be unexpected.

Alcohol and Depressants

There is some confusion in the literature concerning whether alcohol interacts with other depressants to produce additive or super-additive (synergistic) results. In general, however, it can be said that alcohol in interaction with sedatives and/or tranquilizers results in at least an additive effect and may, in some cases result in a synergistic effect.

An example of a synergistic effect would be if a particular dosage of a barbiturate resulted in a deterioration of skills by X amount and particular dosage of alcohol resulted in a decrease in performance of amount Y. When the two drugs in their respective dosages were administered to the individual, a deterioration of X + Y + Z resulted. In other words the combined deterioration

was greater than the sum of its parts.

In summary, it can be expected that a sedative or tranquilizer taken while alcohol is present in the body will have a greater depressive effect than if alcohol were not present and vice versa.

Alcohol and Stimulants

Since alcohol is a central nervous system depressant, it has been expected that central nervous system stimulants such as amphetamine and caffeine, would antagonize or neutralize the effects of alcohol. This, however, has not always proved to be the case. There is some research evidence that stimulants such as amphetamines when taken prior to the ingestion of alcohol may lessen or prolong the onset of alcohol intoxication due to a decreased permeability of the stomach lining. There are also some indications, that for very low blood alcohol concentrations (BAC), amphetamines may reverse some of the impairment due to alcohol.

For the most part, however, the administration of stimulants to persons already impaired by alcohol has not resulted in any decrease in physiological impairment. The criteria most closely associated with alcohol impairment is the blood alcohol content (BAC). In no case (with any drug), does it appear that the BAC is affected by ingestion of the drug. Often the administration of stimulants to alcohol-impaired persons has resulted in subjective feelings of increased alertness and, in some cases, an improvement in unskilled tasks. However, with regard to skilled tasks or tasks requiring concentration or deliberation, the stimulant does not appear to improve performance and has in some cases added to the depressant effects of alcohol and/or further deteriorated performance in such tasks (53). There is some speculation that increased alertness and confidence without concomitant increases in coordinative ability may present even greater danger to driving than alcohol impairment

alone (25).

With regard to the interaction of alcohol and caffeine, generally the same results have been reported as with amphetamines. Some investigators have reported an initial but brief subjective elevation in alertness about one-half hour after the ingestion of the coffee. However, this alertness soon disappears, and no indications of increased psychomotor coordination have been observed (1,25). In some cases coordination has deteriorated.

Tobacco in combination with alcohol or with alcohol and coffee has been found to deteriorate performance to an even greater degree (1, 41) and has been found, in some cases, to offset even the initial alerting effects of coffee on intoxicated persons (1). Research has indicated that nicotine in combination with alcohol provides a more toxic response than either alcohol, or tobacco alone.

Alcohol with Hallucinogens or Narcotics

Little is known concerning the interaction effects of alcohol in combination with hallucinogens or narcotics. Forney and Hughes (25) have indicated that narcotics are primarily central nervous system depressants and that additive effects would be expected. Limited research appears to support such conclusions with regard to the opiate derivatives.

With regard to the hallucinogens, Forney and Hughes (25) have pointed out that it is difficult to study such interactions in laboratory situations for several reasons including personality differences between normal subjects and drug users as well as ethical considerations. Worth noting, however, is the practice among marihuana users to combine the use of alcoholic beverages, (usually wine) with marihuana smoking, whether to maintain the effects of the "pot", reduce the harshness of marihuana smoke or merely to quench one's thirst. The effects of such combined use have not been investigated.

CHAPTER 3. LABORATORY INVESTIGATIONS CONCERNING THE EFFECTS OF DRUGS

There have been numerous investigations which have been concerned with the effects of drugs on both man and other animals. This chapter will deal only with those studies which have investigated driving-related behavior as a function of drug use. Special emphasis is given to those studies which have employed a driving simulator of some sort in measuring the effects of drugs.

It should be pointed out that most research regarding the effects of alcohol on driving skills and judgment has related such effects to the concentration of alcohol in the blood. This has not been the case with regard to the evaluation of other drugs on driving-related activities. In most cases the resultant effects have been related only to dosage levels. It has been suggested that the major failure of early research on alcohol was that it was based on dosage rather than on blood concentration levels.

Non-Prescription Drugs

In a review of the literature, only one study was found which dealt exclusively with non-prescription or over-the-counter drugs in a driving-related task. Carter (10) administered maximum normal dosages on eleven non-prescription drugs to 18 subjects. An equal number of placebos were also administered. The subjects were tested on a driving apparatus designed to test the psychophysical skills of the individuals. These skills included: reaction time; depth perception; visual acuity; peripheral vision; glare recovery; steadiness and color vision.

The results of the study indicated that the selected non-prescription drugs had no significant effect on the skills measured. Rather, there was a trend toward the improvement of mean scores after some of the drugs had been administered.

Prescription Drugs (Sedatives, Tranquilizers, Stimulants)

Generally, simulator and other laboratory studies have been consistent in showing that sedatives and tranquilizers deteriorate performance on driving-related skills. They have also been consistent in demonstrating a greater deteriorating effect with such drugs when alcohol is also ingested. Studies which have involved stimulants have been somewhat less consistent in their findings both with and without the additional factor of alcohol.

Doenicke (20) tested 25 volunteers with 200 mg. of Butabarbital (sedative) and with a controlled dosage of alcohol. The tests showed that up to 24 hours after the barbiturate narcosis, abilities necessary to safe driving were impaired. Alcohol enhanced the effects.

Kieholz and co-workers (36) tested 200 healthy subjects on a driving simulator after an intake of (1) a placebo; (2) 20 mg. chlordiazepoxide (tranquilizer); (3) 800 mg. meprobamate (tranquilizer); (4) 200 mg. phenobarbital (long-acting sedative) and (5) 200 mg. methylprylon. All drug conditions were tested alone and in combination with alcohol. The results revealed that the single dosages of chlordiazepoxide and meprobamate decreased performance to a greater degree than did the other drugs. Alcohol in combination with any of the drug conditions resulted in further deterioration of performance and the authors reported a synergistic effect.

Loomis (42) investigated the effects of alcohol on persons using tranquilizers. Male human subjects who had performed simulated driving tasks previously without the administration of drugs were retested after administration of tranquilizers alone or after tranquilizers plus alcohol. Loomis reported that a 200 mg. dose of meprobamate resulted on the average in an eight

percent reduction of performance in the simulated driving tasks whereas an 800 mg. dose resulted in a sixteen percent reduction. A 25 mg. dosage of chlorpromazine resulted in twenty-eight percent deterioration in performance. Finally, while a 25 mg. dose of secobarbital did not impair performance, a ten percent deterioration was found after administration of a 50 mg. dose.

With regard to alcohol the author concluded that if the dose is sufficiently large, the tranquilizer-induced performance will at least summate with the effects of alcohol.

Loomis and West (43) also studied the effects of meprobamate, chlorpromazine and secobarbital in a simulated driving task. The results of this investigation indicated that chlorpromazine appeared to produce impaired performance after a delayed onset. Meprobamate impaired performance two hours after the first dose and one hour after the second dose. Secobarbital produced a prompt, intense impairment of performance, which continued throughout the remainder of the day.

Miller and Uhr (49) however, investigated the effects of double the normal dosages of meprobamate with and without alcohol as well as the effects of amphetamine and alcohol alone. These investigators reported no deterioration in performance in the simulated driving task under any condition except for the "alcohol alone" condition in which a somewhat greater degree of unsteadiness was demonstrated.

Using psychologically disturbed persons as subjects, Smith, Uhr, Pollard and Miller (70) found indications of improved simulator performance among some groups of subjects after administration of a tranquilizer (benactazine hydrochloride or Suavitil).

In two separate investigations Uhr and Miller (81) found that meprobamate slowed reaction time and decreased accuracy on a simulated driving task. Tranquil, which was administered in the first investigation, was also found to lead to a general impairment of performance on driving.

Most investigations concerning stimulants such as caffeine and amphetamines have also involved the use of alcohol. A German study (1) reported that subjective effects of alcohol were alleviated 15 to 20 minutes after the administration of coffee and that speech improved. Nevertheless, the authors reported that recovery was of short duration and was followed by a state of such pronounced relaxation as to constitute a safety hazard in driving. If coffee drinking was accompanied by smoking, any sobering effect of coffee was in large part offset by the nicotine.

In a review of the literature concerning the effects of caffeine on alcohol intoxication, Muller-Limmroth (53) reported that most laboratory investigations have shown that caffeine is not only incapable of neutralizing the alcohol effect, but actually enhances it. The author further suggests that the same effects can be shown for the amphetamines.

Kraft (40) reviewed the manners in which fatigue can be combated. However, he pointed out that fatigue as caused by alcohol is difficult to compensate for. He cites experiments on a driving simulator to support his suggestions. In these experiments performance decrement due to alcohol was not normalized by .2 mg. caffeine; was first normalized by 9 mg. methamphetamine, but afterwards the performance was again impaired relative to the blood alcohol level. (The blood alcohol level involved is not clear.)

Finally, in another German investigation, Paulus and Mallach (58) reported

that in experiments carried out with a sobriety agent containing caffeine, not only did the drug have no effect on blood alcohol content, but none of the 12 persons tested showed subjective or objective sobriety.

Generally, laboratory experiments conducted with stimulants, such as caffeine or amphetamines, in conjunction with alcohol have failed to show an improvement in motor performance. Studies have also indicated that tobacco smoking enhances the effects of alcohol.

Marihuana

An Attitudinal Survey

It has already been suggested that one of the potential problems presented to traffic involvements by marihuana users is the tendency to over-evaluate their driving abilities. On the other hand, the effects of LSD, for example, are sufficiently disorienting that most users may not drive while under the influence of the drug. This may be an important factor with regard to driving safety as there is some speculation that frequent users of certain drugs drive less frequently while or after using such drugs than does the frequent alcohol user.

Although there is no substantial proof for the latter suggestion, one study was conducted which pertains to the suggestion concerning the self-evaluation of marihuana smokers. Klein, Davis and Blackbourne undertook a questionnaire survey in four academic institutions in Florida (38). The respondents were categorized in five groups: (1) non-users; (2) previous users; (3) users less than four times per month; (4) users 4 to 8 times per month; and (5) users more than 8 times per month. For each group, frequency of alcohol and tobacco use was determined as well as subjective evaluations of

ability to judge speed, time, and reaction time. In addition, information was obtained with regard to traffic violations, and license revocations. Finally, opinions were obtained concerning whether or not the use of marihuana should be permitted in various vehicle driving or operating capacities.

One of the study's findings was that abstainers from marihuana were much less prone to the use of other drugs (including alcohol and tobacco) than were users of marihuana. As the rate of marihuana use increased so did the frequency of use of other drugs increase (including LSD and heroin).

Another finding of the study was that there was a strong social cohesion among users. Most of the frequent users rated the majority of their friends as users. On the other hand, most non-users rated the majority of their friends to be non-users. Thus we have a suggestion of a possible group influence, although persons with similar characteristics and desires probably tend to associate with each other to begin with.

One of the more unique findings of the study was that former and infrequent users downgraded their physical abilities while under the influence of marihuana much more frequently (2 to 3 times as frequently) as did chronic users.

With regard to traffic involvements while under the influence of marihuana, the authors reported that eighteen percent of the infrequent users and fifty three percent of the frequent users indicated having been stopped by the police while under the influence of marihuana. Furthermore, as the frequency of marihuana use among the groups increased, the number of license revocations also increased. Apparently no attempt was made to compare the number of times they were stopped while under the influence of marihuana as opposed to the

number of times they were stopped while not under the influence. Thus, the data do not give any indication of whether the violations were due to the effects of the marihuana or whether they were the result of poor driving habits in the first place.

Perhaps one of the most interesting aspects of the study was that while infrequent users and non-users were relatively consistent in recommending that persons should not be allowed to operate aircraft, taxicabs, or private automobiles, while using marihuana, chronic users were inconsistent in that the further away from their own personal experiences each task became (i.e., from automobile to aircraft operation) the more prone they were to advocate non-permissiveness with regard to marihuana use.

Certainly, any implications from the reported results are subject to a number of complicating factors such as personality characteristics, socio-economic status and many other variables which were uncontrolled for. Thus, the results are interesting from a speculative point of view only.

Other aspects of the study involving somewhat of a case report approach indicated that users of marihuana suffered from various hallucinations while driving (such as inverted roadways and small hills appearing to be vertical) and that many users were able to "pull themselves out" of the influence of the drug in the presence of a police officer. All such reports were purely subjective, yet worthy of consideration.

A Laboratory Study Concerning Attitudes and Performance

An interesting comparison to both the methodology and the findings of the above study is found in an investigation by Weil, Zinberg, and Nelson (91). In a well-controlled study, the design of which included controlled dosages of

THC content, placebo conditions involving the smoking of marihuana stalk material (which tastes and smells similar to regular marihuana but has no THC content), and a double blind approach, these investigators reported several controversial findings.

Perhaps most interesting, at least from a controversial point of view was the finding that inexperienced smokers who claimed not to be "high" during any of the experimental conditions, demonstrated impaired performance on simple intellectual and psychomotor tests while under the marihuana condition. On the other hand, experienced smokers who admitted to being "high" under the marihuana condition, demonstrated less performance impairment and in some cases performance enhancement under this condition.

Other controversial findings of the study include no change in pupil dilation, respiratory rate or blood sugar as a result of marihuana use. Increases in heart rate and dilation of conjunctival blood vessels, however, were confirmed.

It was reported that in a neutral setting, such as that under which the tests were conducted, the effects of marihuana appear to reach a maximum within one-half hour of administration; to be diminished after approximately one hour and to be completely dissipated after three hours.

A Simulator Study

Another laboratory investigation involving the effects of marihuana smoking was conducted by Crancer and co-workers (13) and is further discussed in chapter 5. Briefly, these investigators compared the simulated driving performances of marihuana smokers while under the influence of: (1) marihuana; (2) alcohol; or (3) neither drug. These investigators found that while alcohol

significantly deteriorated the performance on the driving simulator, marihuana did not significantly do so. Kalant (32) has criticized this study on various aspects, including the exclusive use of marihuana smokers as well as the use of a "normal marihuana high" versus a "legally drunk" alcohol condition. It is extremely relevant however, that the blood alcohol levels associated with "social drinking" do produce statistically significant impairment effects in laboratory tasks whereas "pot" doses in the social usage range apparently do not.

Summary of Laboratory Investigations

Laboratory investigations have been employed to determine the effects of drug use on various driving-related abilities. In some of such investigations, devices have been employed which simulate some aspect or aspects of the driving task. The results of such investigations have been as follows:

1. Non-prescription drugs (other than alcohol, caffeine and nicotine) do not appear to have significant adverse effects on driving-related skills.
2. Alcohol has consistently been found to impair such skills.
3. Cigarette smoking and coffee drinking have sometimes been found to impair skills related to driving.
4. Most prescription drugs taken in both normal and excessive dosages have been found to impair performance under simulated driving conditions. This has been the case, especially with regard to the administration of various psychotropic drugs such as the sedatives, tranquilizers, and stimulants.
 - a. With regard to depressant drugs such as the tranquilizers and sedatives, performance deterioration has primarily been

attributed to drowsiness, extreme relaxation and inability to concentrate.

- b. With regard to stimulant drugs, such as the amphetamines, performance impairment has been attributed to irritability, overactivity, overestimation of abilities and a lack of concentration.

5. Investigations concerning the interaction of alcohol with other drugs have generally found additive depressant effects with an accompanying increase in skill impairment.

- a. With depressant drugs, this additive effect has consistently been reported and in some cases a super-additive or synergistic effect has been suggested.

- b. The interaction effects of alcohol and various stimulants have been less consistent. In some cases, it has been found that stimulants have been able to counteract the effects of very low concentrations of alcohol. Generally, however, while subjective feelings of increased alertness have been reported, no accompanying improvement of motor skills has been indicated. In some cases, stimulants have been found to add to the depressant effects and skill impairment caused by alcohol.

6. In no case has any drug been found to alter the blood alcohol concentration in the human body.

7. Limited investigations concerning the effects of marihuana on driving-related skills have failed to indicate any significant performance deterioration under such conditions. (See additional note on next page).

8. No investigations were found which examined the effects of the more potent hallucinogens such as LSD or of narcotic drugs on driving-related skills. Several ethical and methodological problems are involved in conducting such investigations.
9. No laboratory studies have investigated the effects of drugs in relation to their level of concentration in the blood.

Additional Note:

Recent preliminary results from an ongoing Federally supported research project on the West Coast, have indicated a significant deteriorating effect on attention by marihuana as well as by alcohol. The effects due to the two drugs, however, appear to be qualitatively quite different.

CHAPTER 4. THE ASSESSMENT OF RISK

It is difficult to establish how much of an increase in crash risk is associated with the use of mind altering drugs. Some of the more evident reasons for this difficulty include:

- (1) the wide variety of such drugs which are available to the consumer (both legally and illegally);
- (2) the many differences in both quantitative and qualitative effects which these drugs may have on a user;
- (3) the differences in duration of effect associated with such drugs;
- (4) possible cumulative and/or interaction effects resulting from prolonged or combined drug usage (i.e. in conjunction with alcohol);
- (5) the familiar research problem of individual differences in reaction to such drugs;

Because of these many variations, the establishment of relationships between crash risk and drug concentration levels presents a formidable task. A solution to this problem will require a considerable amount of concentrated and systematic research.

In addition, a somewhat different problem associated with research in this area is the fact that detection of most mind altering drugs in the body fluids of users is more difficult than is detection of alcohol in such samples. Several years of research have been devoted to the development of practical detection devices for alcohol and it can be expected that at least as much time will be required to develop comparable tests for detecting the wide variety of other drugs which may be present in drivers and pedestrians. It should be pointed out that some drugs such as marihuana and LSD are for practical purposes undetectable in users at the present time.

High Risk Groups of Drug Users

With these limitations in mind, however, some researchers have attempted to delineate the categories of drug users which appear to present the greatest crash risk. Based on data available in the early 1960's, Waller (87) felt that greater crash risk may exist among certain groups of drug users and that perhaps such groups should receive more attention with regard to law enforcement. Waller also pointed out, however, that the most frequently used enforcement procedure -- revocation of drivers license -- proved to be ineffectual in most cases. The groups of drug users which Waller suggested as presenting potentially greater risk to the traffic situation included:

- (1) Barbiturate addicts: because of the notorious ability of these drugs to cause drowsiness;
- (2) Heroin addicts;
- (3) Hallucinogen users -- primarily those who frequent the use of LSD at least once a month;
- (4) Amphetamine and other stimulant users, who constitute a group which has been suspected of but not proven to have been causally associated with highway crashes.

Waller also included in his list persons suffering from psychopathic and sociopathic personality problems.

More recently, Waller (86) has indicated that users of amphetamines and LSD are of primary concern with regard to crash risk. In the paper he also suggests, on the basis of a California study (88), that "no excess risk appears to be associated with the use of marihuana, the drug most frequently involved in convictions." Studies conducted in Canada have further emphasized the potential dangers in amphetamine use.

Detecting Drugs in Users

It has already been suggested that the problem of detecting drugs in the biological samples of users is much more complex than is the detection of alcohol. In addition to the wide variety of drugs which could be present in such samples, there are many variations in the duration times with which such drugs remain in the body in detectable amounts. Soehring and Walters (73) have pointed out some of the problems involved:

"...The ideal conditions prevailing in ethanol decomposition... cannot be transferred to drugs. In general, it appears that the 'blood level' cannot be regarded as a reliable criterion for the effect of different drugs....

Many active drugs can only be separated with difficulty from their inactivated decomposed forms.... Some drugs in therapeutic doses can be found in the urine for many days after ingestion..."

Another problem involved in post-crash drug detection pertains to the medical application of drugs in the post-crash period. In many cases, it has been difficult to determine which drugs were administered after the crash and which were present in the individual before the crash, since samples are not analyzed immediately and reliance must be placed on hospital records for verification. For this reason many investigations have been limited to victims "immediately killed" or victims who die within a very short time (i.e. 8 hours) after the crash.

The Problem of Assessing Increased Risk Due to Drug Abuse

There is little doubt that the use or abuse of a large number of drugs may deteriorate the skills and judgements required for the safe operation of a motor vehicle. However, this is not sufficient evidence on which to generalize that drugs are contributing disproportionately to highway crashes. It may well be that the abuse of drugs other than alcohol is making a very minor contribution to highway crashes. Certainly any contribution at all is undesirable. However, when one looks at the problem objectively, it is evident that misplaced counter-

measure emphasis may cost more lives than it saves by detracting from countermeasures aimed at more substantial problems.

In order to assess the magnitude of the problem several questions must be answered with some degree of reliability. These include:

- (1) How many drug users drive while directly under the influence of such drugs?
- (2) For what purposes and with what frequency do such persons drive?
- (3) Are such users over-represented in crash or violation population?
- (4) How many of such crashes and/or violations are directly attributable to drug use and how many are due to other personality characteristics?
- (5) What type of crashes or violations are characteristic of this group?
- (6) Can the problem be identified before crashes occur?
- (7) What countermeasures are suggested and which are already available?

In research terms, the primary problem involves the determination of crash risk per unit miles for drug users as compared with that of persons using the roads under similar circumstances who do not use drugs. In addition it must be determined how much of this increase in crash risk is due primarily or secondarily to drug use per se rather than to some other correlated factor. None of the above questions have been answered to any acceptable degree to date.

Any estimates of drug use in the general or driving population which are available to date have been obtained primarily through questionnaire surveys. Several problems are evident from such surveys. First of all, although some researchers have been more successful, generally less than a fifty percent response is obtained from such surveys. Further, there are indications that those who do respond to such surveys are in many ways different from those who

do not, thus introducing a bias. Finally, the validity of the responses to such questionnaires depends upon both the honesty and the memory of the respondents. Somewhat related to this problem is the fact that studies which have compared data obtained through questioning (questionnaires and/or interviews) with that obtained by means of analysis of biological samples have revealed substantial discrepancies in the obtained results (11, 23, 24).

Another means for determining the use of drugs which has been employed involves the examination of medical records. While this method is somewhat more objective than questionnaires, there is the bias problem of limiting the sample to only those persons who have medical records.

These methods, however, have been the most frequently employed for determining the extent of drug use in general and/or driving populations. Other methods have been or should be employed in order to determine the impact which such drug use or abuse may be having on crashes and/or violations. Waller (86) has discussed some of these methods which include:

(1) Laboratory investigations which are appropriate for determining the effects which particular drugs may be having on driving-related performance. However, it is difficult to generalize such results to real driving situations. An additional fault which has been characteristic of this method is the fact that laboratory investigations have not attempted to relate performance decrement to drug concentration levels;

(2) Anecdotal reports and case histories, which in some cases may be useful to indicate possible problems and/or associated mechanisms, but which are inadequate for determining the extent of the problems. Also a primary problem involved with case histories and anecdotal reports is the sensationalism that usually accompanies them in the general news media;

(3) Systematic analysis of body fluids taken from crash victims is ade-

quate for determining the frequency with which drugs are involved in crashes but not the extent to which they contributed to the crashes. A basic problem involved in this type of investigation is that all drugs are not detectable in human body fluid samples.

Much of the data which is presently available concerning the involvement of drugs in fatal crashes has been obtained in this manner. However, as it has been pointed out by Kibrick and Smart (35):

"....few investigators have inquired about the same drugs. Still fewer have made laboratory screening for them. Also, no two investigators have used similar criteria for selecting their cases and thus different populations are described. Many 'procedures' for data collection do not seem to be reliable nor can they be reproduced by others for comparative purposes."

Thus, in addition to the unavailability of adequate testing procedures, it is apparent that a problem exists with regard to unstandardized sampling and screening techniques;

(4) Comparisons of drug concentration levels of crash victims and of non-involved drivers operating vehicles under similar circumstances is perhaps the most adequate means for determining the impact which drug use per se may be having on highway crashes. However, this procedure has not been used to investigate drugs other than alcohol and involves several additional complexities such as matching comparison groups on a variety of variables and problems associated with stopping and testing non-crash-involved drivers;

(5) Comparisons of crash and/or violation records of drug users and non-users comprises an alternative method for assessing the impact of drug use on highway incidents. However, as Waller (86) has pointed out, unless all or most of the excess in crashes and/or violations occurred while the drug in question was present, it cannot be determined whether drug use per se or other factors are responsible for the excess. This points to the problem of determining how many highway incidents in which drug users are involved occur while

such users "under the influence" of a drug and how many occur in the absence of such "influence".

It will be beneficial to keep the characteristics of such research techniques in mind while reviewing the research results of the next chapter.

CHAPTER 5. INCIDENCE OF DRUG USE IN HIGHWAY SITUATIONS

The following is a review of the more pertinent estimates and drug screening investigations carried out to date. Many of these studies have already been covered in an excellent review by Kibrick and Smart (35).

Studies of General and Driving Populations

The Use of "legal" drugs in the General Population

Estimates of drug use in the U.S. have been approached primarily by means of questionnaire surveys and by interpolation of other types of data. The results of such estimates have been somewhat consistent. However, in relatively few instances has any extensive attempt been made to separate frequent from occasional users; multiple drug from single drug users; or lesser mind-altering drugs (i.e., Compoz, NoDoz, Donnagel, Sominex, etc.) from the more powerful psychotropes (i.e., amphetamines, barbiturates, marihuana, etc.).

Parry (57) reported the results of two independent questionnaire surveys of psychotropic drug use among the U.S. adult population. He reported that twenty-five percent of the adult population was currently using psychotropes and nearly half of the population had used them some time in the past. He also indicated more frequent drug usage among women than among men and more frequent use of sedatives among the elderly and stimulants among the younger constituents of the society. This investigation included both prescription and non-prescription drugs.

Manheimer (47) in an investigation of psychotherapeutic drug use among adults in California also reported that about fifty percent of that population had used legal prescription or non-prescription drugs (over-the-counter) such as stimulants, tranquilizers, and sedatives. Twenty-nine percent of this population had used one or more of such drugs in the past twelve months.

Perhaps of greatest importance to highway safety is the estimate that twelve percent of the men and twenty-two percent of the women in Manheimer's study were frequent users of either tranquilizers and/or sedatives and/or stimulants. This figure is somewhat comparable to Parry's estimate of "present-users" (twenty-five percent). Tranquilizers were reported as the most frequently used drugs (fourteen percent women and twelve percent men), while stimulants (eight percent women and five percent men) and sedatives (eight percent women and four percent men) were about equally used.

It should be pointed out that the above surveys are limited for the most part to the "legal" use of prescription and non-prescription drugs. Little information is available concerning the "illegal" use of such drugs, although the U. S. Food and Drug Administration estimates that approximately half of the manufactured stimulants and depressants find their way to illegal channels. Even less information is available concerning the extent to which "legal" psychotropes obtained through prescriptions are used in excessive dosages or in conjunction with other drugs.

The Use of "illegal" drugs in the General Population

Marihuana is the most commonly used "illegal" drug. The use of marihuana has been investigated primarily within college and university settings. Surveys conducted on college campuses in the late 1960's indicated that at least twenty to twenty-five percent of the students had at least tried marihuana. Although there are some regional differences in the extent of "pot-smoking" on campuses it is much more probable that fifty percent of today's college and university students have smoked pot at least on one occasion. No accurate information is available concerning the percentage of students who are frequent users. It should be pointed out that in a 1968 study conducted by Weil, Zinberg, and

Nelson (91) on an eastern university campus, the investigators found it extremely difficult to find nine students who had never tried marihuana.

With regard to the general population, there have been estimates by polling agencies indicating that at least twelve million Americans (six percent) have tried marihuana. Again, it is suspected that such estimates are highly conservative and that the relatively high percentage of usage among GIs returning from Viet-Nam will further increase the percentage of "pot-smokers".

The use of other hallucinogens appears to be considerably less common than is the use of marihuana. More information is needed concerning the percentage of marihuana smokers who also use other drugs. However, it is suspected that most users of other hallucinogens (e.g., LSD, mescaline, DMT, DOET, etc.) are also users of marihuana.

Estimates of the use of narcotics have been based primarily upon the number of known heroin addicts. These estimates place the number of such addicts at nearly 100,000 (.05 percent of the population) with most of these addicts residing in the New York City area. Again, these estimates are probably quite conservative.

Drug Use in Driver Populations

With regard to the United States driving population, estimates are similar to those figures for the adult population as a whole. In the April 30, 1970 issue of Traffic Laws Commentary the Smith, Kline and French pharmaceutical company made an estimate that, as of 1963, between ten percent and twenty percent of the nation's driving population age 16 and older was using prescribed drugs. The U.S. Food and Drug Administration estimated in 1964 that twenty-four percent of all prescribed drugs were psychotropes (mind affecting). The U.S. Department

of Health, Education and Welfare estimates that over-the-counter preparations were being used at about one and one-half times the rate of prescribed drugs (fifteen to thirty percent). The overall estimate of prescribed and over-the-counter drug users ranges from twenty-five percent to fifty percent of the adult population. Again, this figure excludes illegal use and gives no estimate of frequency of use.

By means of interpolation method, Smith (71) estimated that between ten percent and twenty percent of the driving population of California was taking prescribed medication at any one point in time. This figure did not include persons under self-medication or those using drugs for other than medical purposes.

From these estimates it would appear that at least twenty to twenty-five percent of the driving or adult population is using prescribed drugs of which approximately one-fourth are mind affecting psychotropes. To this figure must be added an unknown proportion of adults and young people of driving age who use illegal drugs. Thus, it appears that a substantial proportion of American drivers may be using drugs. What is not known is the number of such people who are using drugs in conjunction with driving activities, how frequently they do so, and in what dosages. Manheimer's estimate of twelve percent of the male population and twenty-two percent of the female who use drugs frequently, would appear to be the most pertinent statistics with regard to highway crash risk. These figures are similar to the Smith, Kline and French estimate that between ten and twenty percent of the driving population uses prescription drugs. Figure 1 summarizes the more pertinent estimates of prescription and non-prescription drug use.

Studies of Crash Involvement

Studies of crash-involved drivers which follow may give some indication

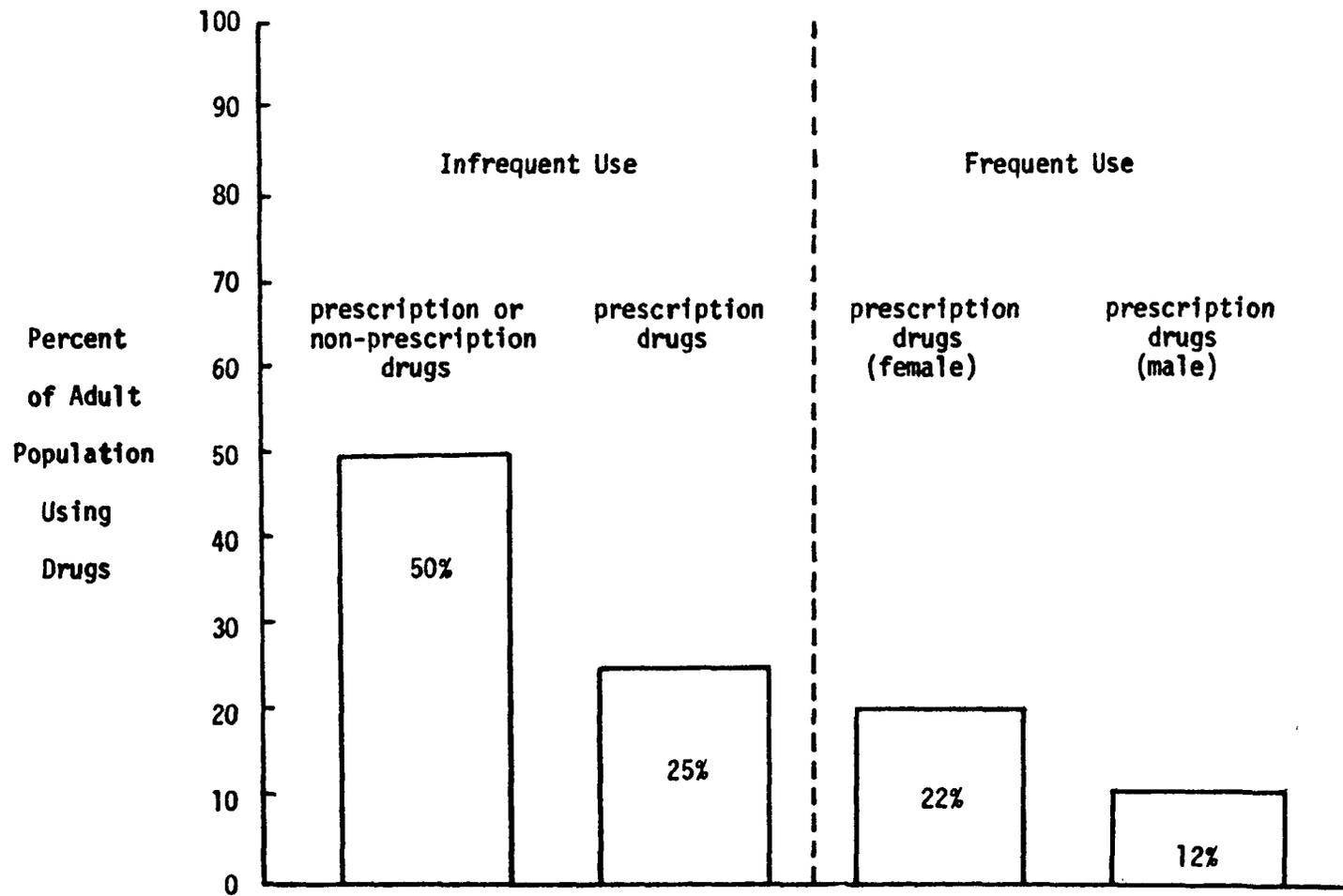


Figure 1. Estimates of Drug Use in Adult or Driving Population

concerning the number of crashes in which drugs were involved, but they do not provide any information concerning whether a greater percentage of crash-involved drivers use drugs than do non-involved drivers.

Fatal Single Vehicle Crashes

Two studies have been carried out to date with regard to drug involvement in single vehicle crashes. A California study (75) conducted blood samples on 772 victims of single vehicle crashes. Of these samples 662 were conducted on men and 110 on women. Drugs which could be detected by the methods employed in this investigation included barbiturates, Miltown and Librium (tranquilizers), caffeine (stimulant), Diabinase (antidiabetic), Disantin (anticonvulsant), and Sulfa (anti-infectant). Thirteen percent (102) of the crash victims had detectable drug concentrations in their blood. In addition to the identifiable drugs, twenty-three of the cases involved drugs which could not be identified. Perhaps the most potentially dangerous of the drugs detected were the barbiturates and tranquilizers. These drugs were found detected in approximately nine percent (65) of the cases analyzed. It appeared that drugs other than alcohol were not over-represented in this study.

A similar study conducted in Florida (16) used ultra-violet screening to detect the presence of drugs in 179 drivers killed "immediately" in fatal single vehicle crashes in Dade county, Florida. In addition these investigators screened for alcohol and carbon monoxide. They found evidence of detectable drugs (including amphetamines) in 4.5 percent (8) of the drivers. However, the report pointed out that more extensive background investigations and testing procedures would have revealed a greater incidence of drug use.

It is interesting to note that both studies revealed a high incidence of alcohol used in conjunction with other drugs. The California report indicated that over sixty percent of the drug users were excessively impaired by alcohol

(BAC greater than .10 % wt./vol.) and the Florida study indicated that half (4) of the drug users also had alcohol present in their blood at time of death. In the California study the percentage of the total population sampled which had alcohol and other drugs present in their blood was approximately nine percent (75). Studies to be cited later indicate approximately seven percent of drinking driver populations use other drugs (excluding tobacco) as well.

All Fatal Crashes

A study reported by Briglia (4) in California screened 1,618 coroner's cases for alcohol and barbiturates (ultraviolet spectrophotometry). Of the total number of cases 23.6 percent showed positive alcohol levels and 9.3 percent showed positive barbiturate levels. With regard to 95 fatal motor vehicle accidents involved in this study, approximately fifty percent had positive blood alcohol levels and less than three percent (3 cases) had positive barbiturate levels. The investigator indicated that more extensive testing would probably reveal a greater drug involvement.

In 1967 the U.S. Army reported a two year study of fatal motor vehicle accidents involving U.S. Army personnel in Europe (82). In this study 90 out of 540 crash victims were screened for drugs including narcotics, barbiturates, tranquilizers, antihistamines and amphetamines. In no case was "more than a therapeutic dose" present. The report did indicate that the tests involved were sensitive enough to detect only larger than therapeutic doses.

Davis (15) reported the results of ultraviolet screening of 306 "immediately killed" drivers. In 5.6 percent (17) of the cases drugs other than alcohol or carbon monoxide were detected in the blood. In half of these drug cases drugs were found in conjunction with alcohol.

Sunshine (76) and Sunshine, Hodnett, Hall and Rieders (77) reported that in both investigations of fatal crash victims only three to four percent involved

the presence of barbiturates. Little other information is available concerning the number of cases screened or the varieties of drugs which could be detected by the method involved.

In a 1969 report of 1000 fatal traffic crashes in Indiana, Konkle (39) reported that nine persons had consumed barbiturates and five persons had consumed stimulants prior to the crash. It is not known what methods were used for drug detection or how many of the victims were actually screened for drugs. In four of the fourteen drug cases (twenty nine percent) alcohol was found in addition to the drugs. This is somewhat lower than other findings concerning drugs in conjunction with alcohol (approximately fifty percent of drug users).

Two studies have been reported in the past year which have investigated drug involvement in fatal traffic crashes. Kaye (33) reported a study conducted in Puerto Rico in which blood samples of 180 crash victims within 25 miles of San Juan were screened for drugs. In seven percent of these cases (12) positive drug concentrations were found. In half of these cases (6) the drug detected was morphine. The remainder of drugs detected included: barbiturates (2), Doriden (1), Thorazine (1), Fiorinal (1) and Salicylate (1). Kaye suggested that the addict may be presenting an increasing problem to traffic conditions.

Perrine, Waller, and Harris (59) investigated the roles of alcohol and other drugs in 46 fatal crashes in Vermont between July, 1968 and March, 1969. In this investigation it was found that drugs were detected in about eleven percent (5) of the total number of cases screened by means of thin layer chromatography. In only one case was a potentially dangerous drug (phenobarbital) detected. Three criteria were used for determining cases in which drugs were screened for. These criteria included: (1) a complete autopsy was performed within 24 hours of death; (2) the victim was at least fifteen years of age; and (3) the death occurred before the administration of any drugs in the post-

crash period. Braunstein, Weinberg and Cortivo (3) screened 188 drivers for the "total spectrum of drugs" which could impair driving and found the presence of such drugs in 3 (1.6 percent) of the cases. No evaluation can be made since details of procedures are not given.

Finally, in a study of fatal aviation accidents Dille and Morris (17) found that in 2 out of 86 fatally injured pilots (two percent) the presence of barbiturates was detected in blood samples.

A comparison of the results of these studies with the estimated percentage of frequent drug users can be found in Figure 2.

Non-Fatal Crash Investigations

It has been difficult to obtain information concerning drug use from non-fatal crash victims due to the fact that biological samples cannot be legally taken from such persons without their consent. Three studies, all foreign, have been cited by Kibrick and Smart (35) in this context. These studies reported in 1962 by Reinartz (64) and Wagner (84) in Germany and by Wangel (85) in Denmark have revealed drug use prior to a non-fatal crash in 15.2 percent, eleven percent and 15 percent of such cases respectively. Generally these figures were obtained by means of questioning and for that reason probably represent conservative estimates. Wagner indicated that sedative (barbiturate) users had the highest percentage of accidents.

A study of non-fatal traffic crashes conducted in Switzerland points out another interesting phenomenon involved in the toxicological investigations which are being reviewed. Im Obersteg and Baumler (30) screened 328 patients hospitalized after traffic, occupational, and non-occupational accidents. The screening process involved both blood and urine tests and thus the drugs which could be detected include amphetamines as well as sedatives and tranquilizers. In nineteen percent of the total number of patients screened, positive blood

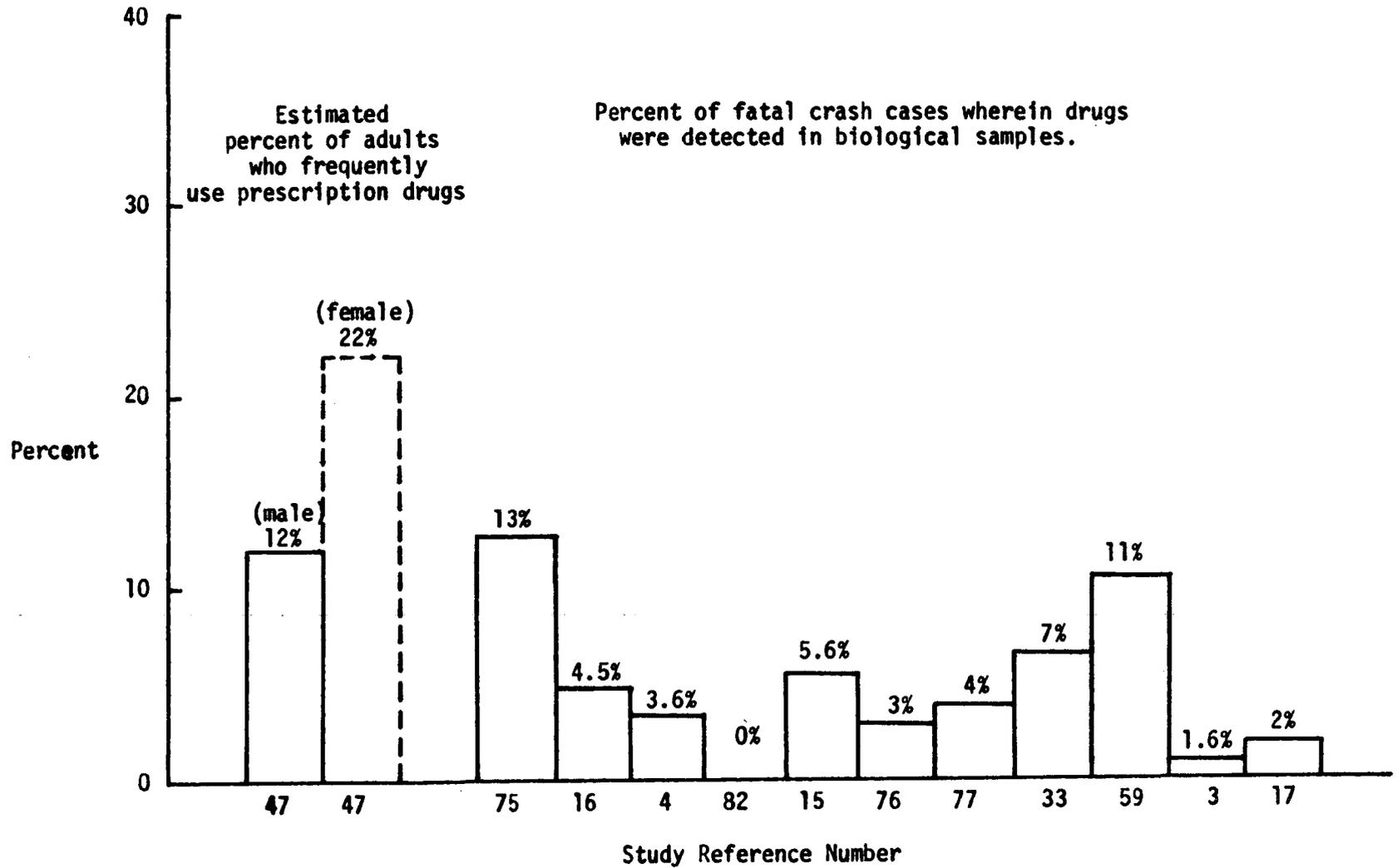


Figure 2. A Comparison of the Percentage of Fatal Crash Cases Wherein Drugs Were Detected With the Estimated Percentage of Frequent Users in Population

alcohol levels were found and in two-thirds of the traffic accident victims blood alcohol concentrations greater than .08 percent were indicated.

The most pertinent aspect of this study from a drug point of view was that drugs were detected in more than 100 of the total number of patients (nearly thirty percent). However, only in 13 cases (four percent) could it be definitely established that the drug had been taken prior to the accident and not afterwards during emergency treatment. It was concluded that in this study, alcohol was a much more important factor in the accidents than were the drugs, but it was estimated that in about four percent of the cases, drug interaction with alcohol was involved. (See Figure 3).

Drug Use in Drinking Driver Populations

Perhaps the most extensive study of drug use in drinking driver populations has been reported by Finkle, Biasotta and Bradford (24) and more recently by Finkle (23).

In the preliminary report, Finkle et al investigated 3,409 routine drinking driver arrests in Santa Clara County, California. The methods used for screening for drugs involved questioning and, in some cases, analysis of blood samples. Sedatives, tranquilizers, antihistamines and minor stimulants were detectable by the methods used. Drugs which were not detectable in this initial phase of the study included: Librium, Valium, phenothiazines, and amphetamines. The results indicated that of 3,406 arrests involving drinking, twenty-one percent of the cases indicated concurrent drug use, and 7.2 percent indicated the use of a mind-altering (psychotropic) drug. Tranquilizers accounted for most of such occurrences followed by sedatives, hypnotics and analgesic narcotics.

An interesting aspect of the study was that drugs were found in twenty-two percent (38) of the 180 cases where the BAC was less than .15 percent and signs of overt intoxication were evident (possible synergism). In approximately one-

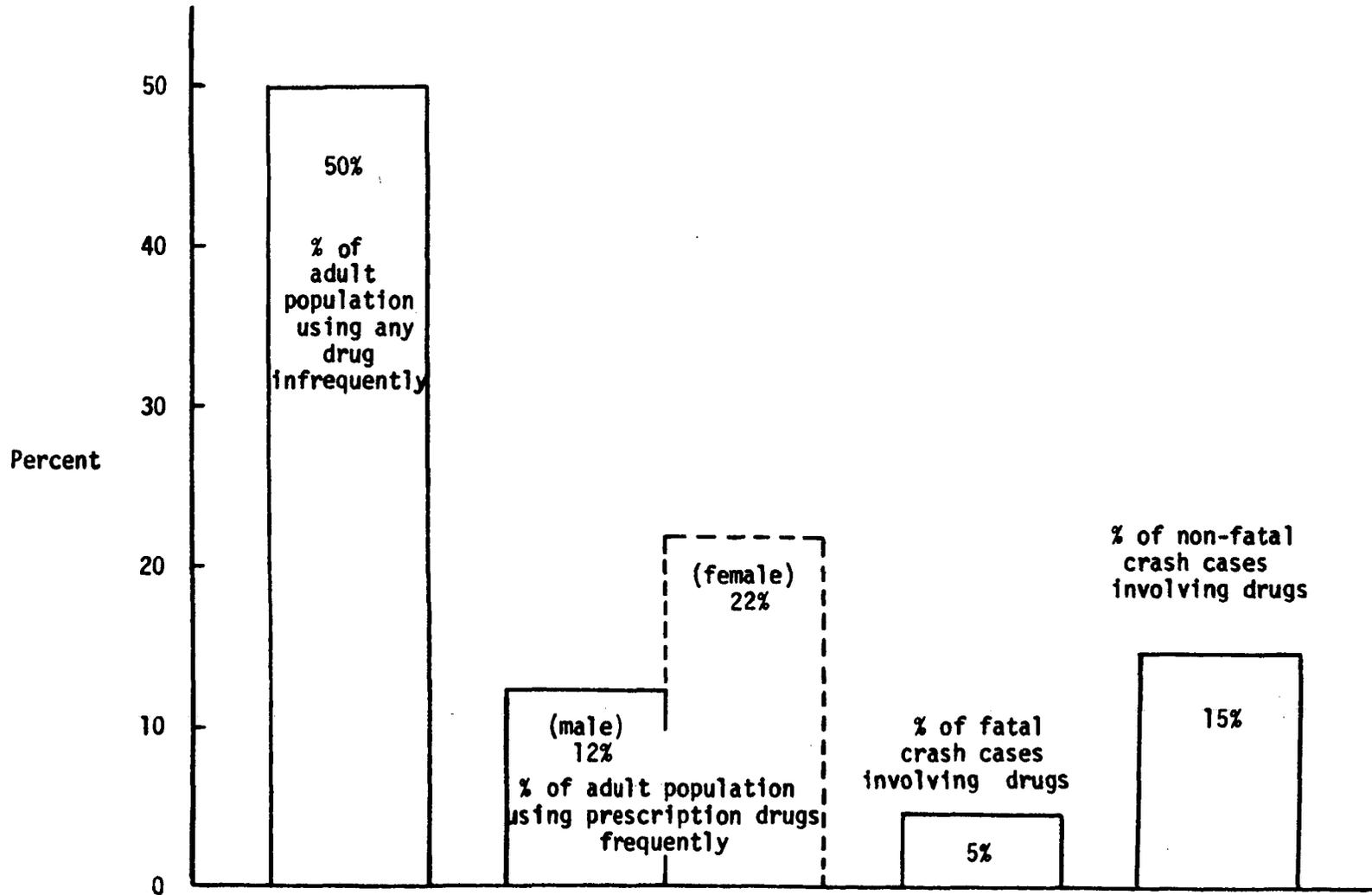


Figure 3. A Comparison of the Percentage of Fatal and Non-fatal Crash Cases Involving Drugs With the Estimated Percentage of the Adult Population Frequently Using Drugs.

third of these instances drug use had not been indicated by questioning.

The results of this preliminary study were such as to prompt the continuation of the study, in greater depth, thus encompassing the three years from 1966 through 1968. A total of 10,436 drinking cases were investigated and 700 chemical analyses were conducted. Drug use was found in approximately twenty-five percent (2,559) of these cases, either by the arresting officer questioning the driver or by chemical analysis. Thirteen percent of these cases involved "problem" drugs.

Of the 700 cases in which an analysis was performed, twenty-two percent (159) indicated the presence of a drug. In approximately one-third of the cases in which drugs were found by analysis, the use of such drugs was not indicated by questioning. The barbiturate sedatives, glutethimide, and meprobamate accounted for nearly half of the 24 drugs detected by analysis and were overwhelmingly predominate in frequency of occurrences. Amphetamines were found in only 6 of the 700 chemical analyses. However, it is not clear how such drugs were screened for.

Another extensive study, the California Single Vehicle Crash Study (75) already cited, found that seventy-two percent of the drivers killed in such crashes were impaired by alcohol (seventy-nine percent had been drinking). Of the total population sampled, 7.2 percent had ingested both psychotropes and alcohol, and over sixty percent of the drug cases involved alcohol in concentrations greater than .10 percent.

Chelton and Whisnant (11) investigated the drug use of 100 alcoholics by means of questioning and chemical analysis and also found a significant discrepancy in the results obtained by means of these two methods. While questioning indicated drug use in nine percent of the cases, chemical analysis revealed that drugs were actually present in thirty-eight percent of the cases. Drugs

which were screened for included tranquilizers and sedatives. The results pointed out the need for verification of data obtained by means of questioning. While such a discrepancy may not exist in questionnaire techniques where anonymity is preserved and/or there is no fear of repercussion, it certainly would appear to be a factor with regard to crash investigations.

A somewhat different aspect of the drinking-driving population was revealed in a study by Gupta and Kofoed (28) who investigated the number of drivers arrested for driving under the influence of alcohol but who had tranquilizers or barbiturates in their systems and not alcohol. These investigators reported that the number of such arrests in Ontario, Canada increased from one case in 1958 to 25 cases in 1964. It is not known how much of this increase is the result of more extensive and/or refined screening procedures.

Perhaps the most apparent conclusions which can be drawn from these investigations of drinking drivers are that: (1) drug use is frequent among such drivers; (2) the use of psychotropes appears to be more common among drinking drivers than among the general driving public or among those involved in fatal traffic crashes; and (3) the results of data obtained through questioning are not consistent with those obtained through analysis. (See Figure 4).

Clinical Populations

Milner (52) conducted a study of 4,020 general practice and 564 psychiatric patients in an Australian clinic. Examination of medical records revealed that a total of sixteen percent of such patients were using prescribed psychotropes. This figure included 8.4 percent of the general practice patients and 73.5 percent of the psychiatric patients. It was estimated that of those people on prescribed medication fifty-seven percent of the men and thirty-five percent of the women ran the risk of driving while using alcohol as well as the prescribed drugs. Of the total population samples (4,584) 7.1 percent were estimated as

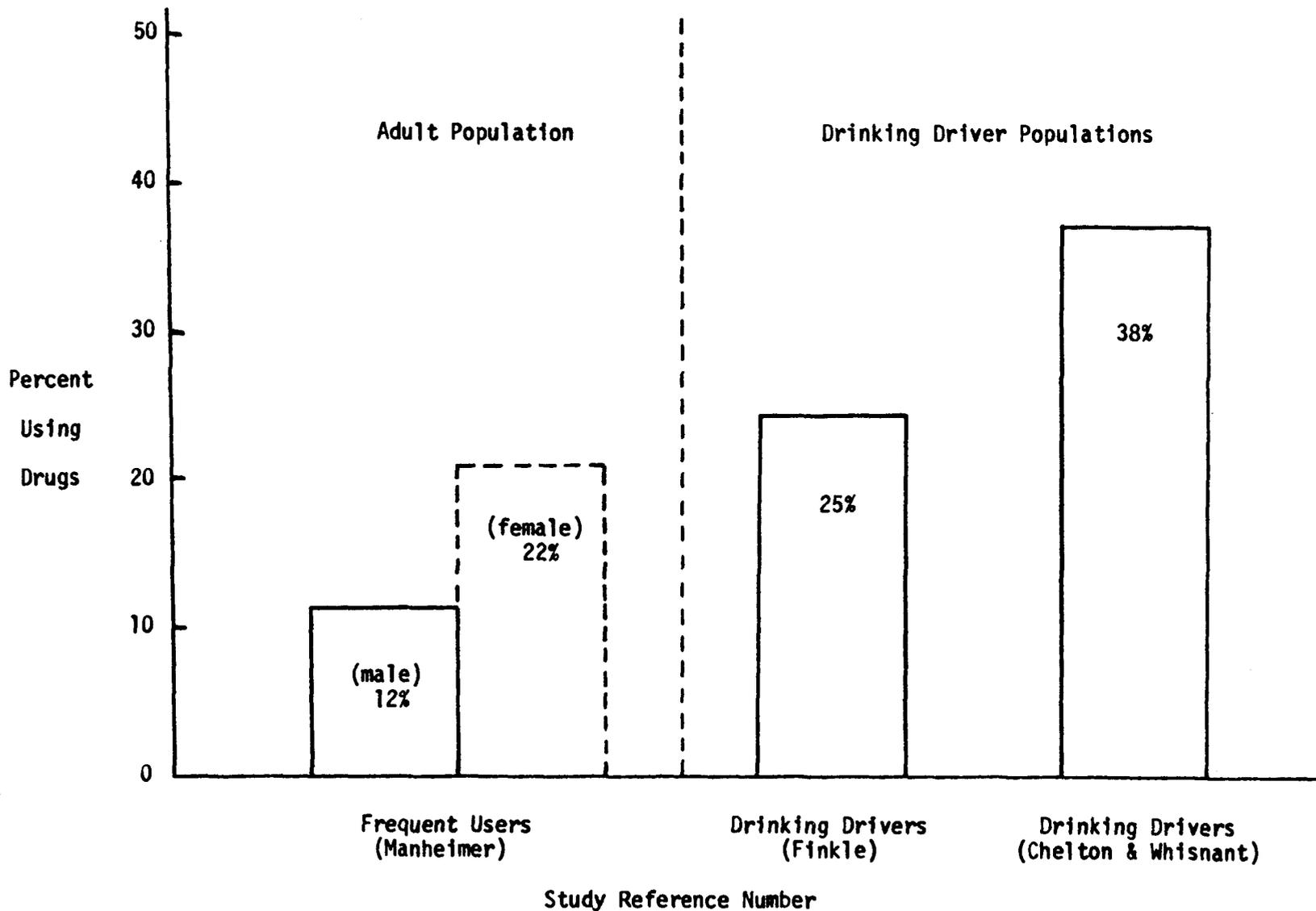


Figure 4. A Comparison of the Percentage of Drug Users in Drinking Driver Populations With the Estimated Percentage of Frequent Drug Users in the Adult Population

combining driving with the use of alcohol and other drugs. The estimate of 7.1 percent of the total population driving while using psychotropes and alcohol is comparable to the estimate of 7.2 percent reported by Finkle et.al. Figure 5 shows the proportion of drug users investigated who also use alcohol.

Studies of Driving Records of Drug Users

Smart, Schmidt and Bateman (69) investigated the driving records of 30 persons who were dependent on psychoactive drugs. These persons were addicted to or dependent upon sedatives, tranquilizers, or stimulants. Half were also dependent upon alcohol. All 30 were interviewed with regard to their traffic records and driving exposure. In addition, their official driving records were checked. Expected accident rates were computed for age and sex groups separately and observed rates were compared with expected rates. The psychoactive drug abusers had accident rates about twice as high as expected for their age, sex and driving exposure. Most of the excess was contributed by those who were heavy users of amphetamines (alone or in combination with other drugs). Frequently these drivers admitted having taken amphetamines prior to an accident. The results indicated that heavy users of (1) alcohol and barbiturates, (2) barbiturates only, and (3) tranquilizers only had lower than expected accident rates.

In 1965 Waller (88) reported the results of a three year study in California in which the driving records of 231 drivers with convictions for illicit drug use were compared with the driving records of approximately 1000 drivers without such convictions. Crash and violation rates were determined on the basis of exposure (per miles traveled). On the basis of calculated expected crash and violation rates per million miles traveled, it was found that the drug users had no significant difference between observed and expected crash rates but had 1.8 times the expected violation rate.

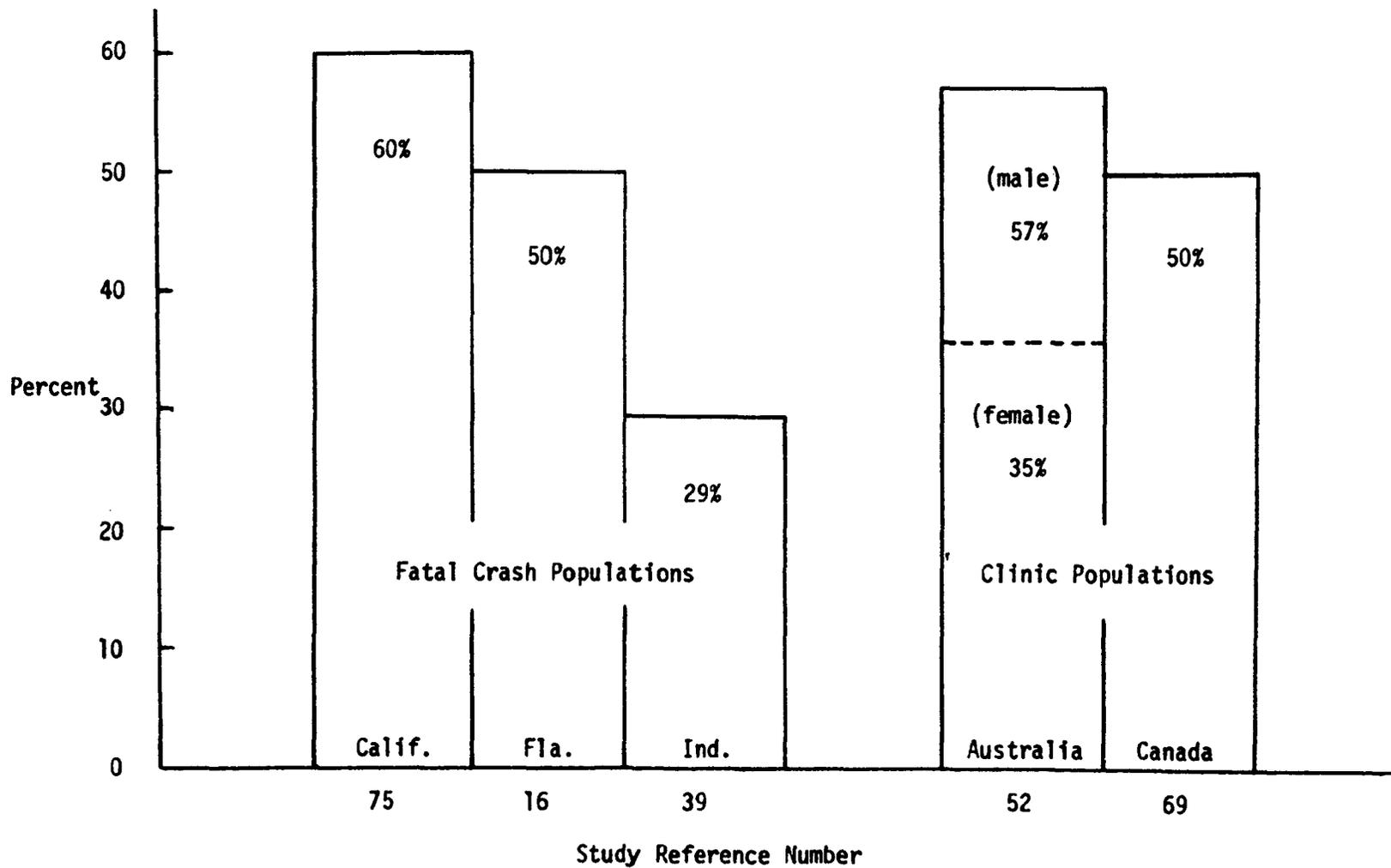


Figure 5. Proportion of Drug Users Who Are Also Excessive Alcohol Users

It was pointed out by Waller that many of the drivers in the illicit drug group had come to the attention of the motor vehicle department because of their excessive violation record and before they began using drugs (usually marihuana). In a later article (87) Waller concluded that there appeared to be no excessive crash risk associated with marihuana smoking, which was the drug most commonly involved in the violations of the preceding study. In this paper Waller also indicated that the use of morphine and other opium derivatives may reduce driving capacity although there is no strong evidence one way or the other.

Even more recently, Waller and Goo (89) noted that in the three year California study, the crashes and violations encountered by the drug-using group were characteristic of those involved in by younger drivers in general and not drug users alone (i.e., excessive speed, violations for defective equipment, etc.).

In a similar study Crancer and Quiring (14) compared crash and citation rates per 100 drivers for 302 persons who were not known to use drugs and for drivers who had been arrested for using various drugs, including heroin, barbiturates, LSD, and marihuana. The samples were matched for age and sex. The drug users were found to have between thirty percent and sixty percent more accidents and approximately one hundred fifty percent more violations than the non-user group. It is interesting to note that the marihuana and narcotics users had twenty-nine percent more accidents than did the control group, while users of "dangerous drugs" (i.e., depressants and stimulants) had fifty-seven percent more accidents than did the control group.

It was also found that the drug group had three times as many convictions for drunk driving as did the average driver in King County, Washington. Thus, the use of alcohol contributed to the high violation rates and possibly to the high accident rates.

An additional finding of this study was that, similar to the Waller study, the accident and violations involved were characteristic of younger drivers.

In order to determine further the underlying factors behind the poor traffic records of marihuana smokers, a simulator study was conducted. In this study 36 marihuana users (not from the violation group) were tested on a driving simulator under three separate conditions: (1) no drug; (2) marihuana "high"; and (3) legally "drunk" (.10 percent BAC). It was found that the performance of these drivers was no worse under the marihuana condition than under the no drug condition. However, under the alcohol condition performance scores were fifty percent worse than under the no drug condition.

The authors caution generalization from this simulator study to on-the-road performance without additional research to substantiate the findings. However, these findings are pertinent in interpreting the results of the previous study with regard to the possible contribution of alcohol in the traffic involvements of drug groups. It should be pointed out, however, that the subjects studied in this investigation did not include the convicted drug drivers used in the former study. It was suggested by the researchers that personality problems, which may have precipitated the use of drugs, may also have been prime contributors to the poor driving records as well. Other researchers (62) have offered support for this theory and it has been suspected of alcoholic groups as well as other drug-using groups.

An investigation of the driving records of opiate users was conducted by the New York State Narcotic Addiction Control Commission and the Department of Motor Vehicles. This study reviewed the driving records of 1,245 of 6,000 addicts who were certified to the State Narcotic Commission for treatment and who were found to have a driver's license and/or a driving record. The investigation disclosed that approximately seventy-five percent of the cases investi-

gated involved at least one accident or violation. This is in contrast to a state average of only twenty percent of the average New York drivers who have accidents or violations on their records. It is not clear, however, to what extent the criteria for selecting the addict group may have biased the results (i.e., selected on the basis of driver license and/or driving record).

In addition, the study cautioned that it cannot be determined from this evaluation if addicts who drive are "dangerous due to their being under the influence of drugs, or if it is due to poor driving habits and accident prone personalities without drugs." However, it was indicated that the addict for one reason or another was much more dangerous on the road than the average New York driver.

The reader is advised to consult appendix B for a summary of research results.

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

I. CONCLUSIONS

1. STATE-OF-THE-ART

In reviewing the literature of the drug-driving area, it is apparent that our present state of knowledge is little more than fragmentary. Several categories of drugs are involved and several different research approaches have been undertaken to determine their effects and impact. Figure 6 comprises an attempt to graphically portray to the reader where, in terms of drug categories, the bulk of such research has been concentrated. This illustration has been derived primarily from the studies reviewed in this report and makes no attempt to depict the thoroughness or number of studies conducted in each area.

Alcohol has also been included in Figure 6 but it should be pointed out that the state-of-the-art with regard to alcohol and driving research is much advanced in comparison to other drugs and driving.

2. GREATEST RESEARCH GAP

It is also apparent from Figure 6 that the greatest gap in our research knowledge is in relation to the effects of hallucinogens in highway situations. One of the reasons for this lack of information is the inability to detect these drugs in users by present methods.

3. THE EFFECTS OF DRUGS ON SKILLS AND JUDGEMENT

Pharmacologically speaking, it has been indicated that the use of mind-altering drugs would be expected to deteriorate the skills and judgement required for safe operation of a motor vehicle. Laboratory investigations appear to support such expectations at least with regard to the more potent prescription psychotropes and alcohol. However, such investigations have not

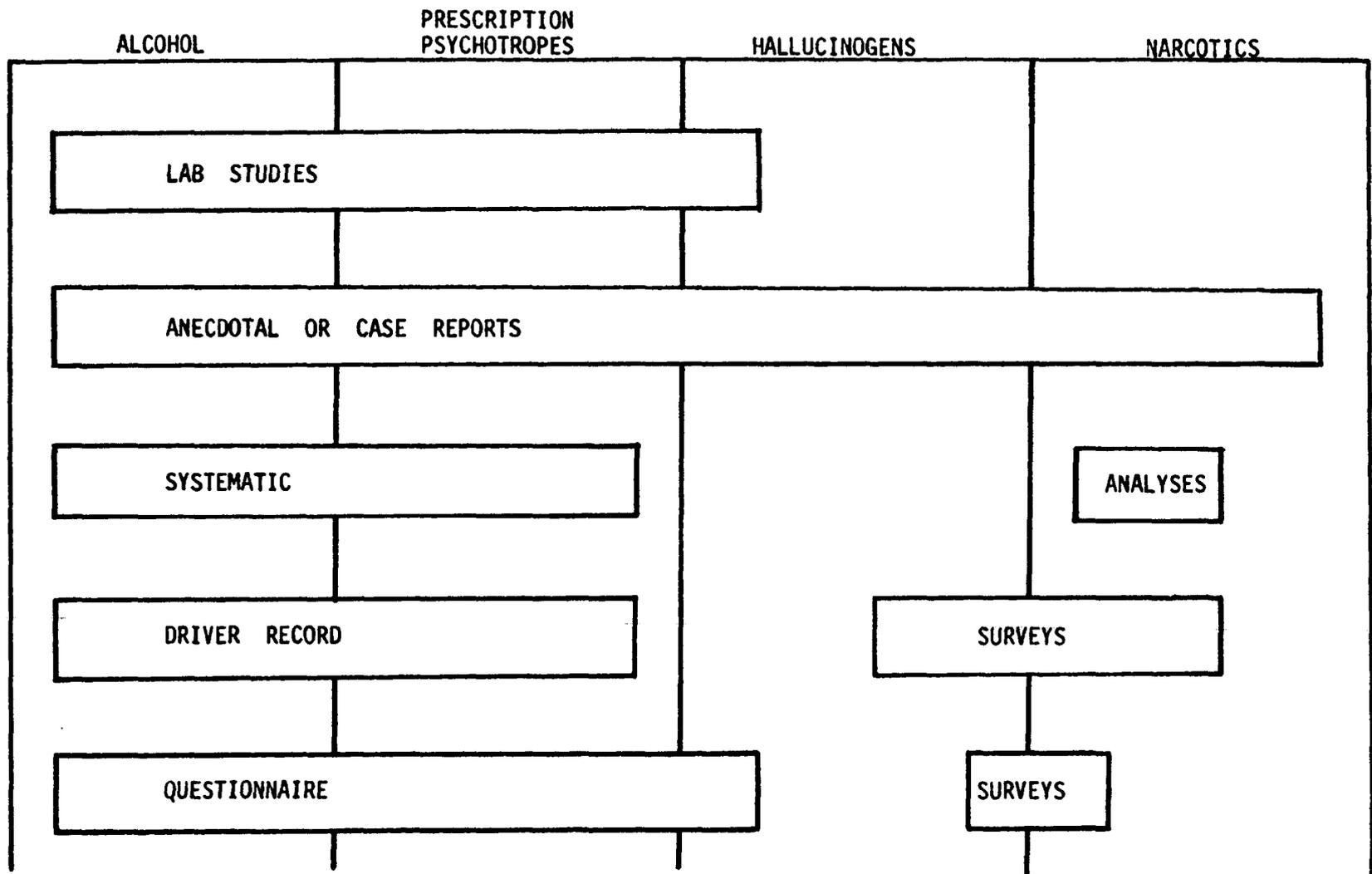


Figure 6. Drug Areas Where Various Research Techniques Have Been Conducted

generally indicated a significant deterioration as a result of the use of marijuana. The effects of more potent hallucinogens and narcotics have been relatively unresearched by these techniques.

Certainly, it cannot be stated on the basis of laboratory information, that the use of drugs is having a major impact on the highway crashes.

4. SUGGESTED INVOLVEMENT IN CRASHES

Evidence from anecdotal and case study reports indicates that in some crashes the use of drugs has been a precipitating factor. However, the extent of such drug involvement cannot be established by such procedures.

Driver and medical record surveys, on the other hand, have suggested that known drug users have higher violation rates and may have higher crash rates than does the average driver. Many of such investigations, however, have failed to control for a number of pertinent variables and have not demonstrated that the use or abuse of drugs per se is a major contributing factor in such crashes and/or violations.

5. PERSONALITY FACTORS

As with alcohol, it appears that frequent users of other drugs differ in certain personality characteristics from non-users. In many cases it appears that such personality dispositions may be the primary contributing factors to the poor driving records of drug users, as such records are often evident before the advent of drug use.

6. "PROBLEM" DRUGS

From driver record surveys, it appears that users of psychoactive prescription drugs have the poorest driving records. More specifically, it appears that users of amphetamines may present the greatest crash risk. Possible

explanations for this high risk include the combination of an increased level of activity and an exaggerated sense of competence commonly induced by the ingestion of this drug.

7. DETECTED INVOLVEMENT IN FATAL CRASHES

Systematic toxicological investigations have suggested that the involvement of drugs in fatal crashes is not greater than would be expected on the basis of the estimated number of frequent drug users in the driving population. However, systematic investigations have been concerned primarily with the detection of prescription and non-prescription drugs in fatal crash victims. They have been inexhaustive in the drugs screened for and inconsistent in their sampling techniques. Because of these failures, it cannot be concluded that drugs are not having a significant impact on highway crashes. Rather, it must be concluded that presently there is no valid evidence that drug use and/or abuse is contributing disproportionately to highway crashes.

8. OVERLAP WITH ALCOHOL USERS

There have also been indications from toxicological investigations, from questionnaire and interview surveys, and from driver and medical record surveys that a large number of drug users are also "excessive" alcohol users. This has been especially apparent in fatal crash studies. It would appear, in view of these research findings, that a reduction in the number of "excessive" alcohol users from the road, may also result in a reduction of the number of drivers using other drugs.

9. ALCOHOL IS THE GREATEST PROBLEM

Most certainly, it can be concluded that, at the present time, problem drinkers and alcoholics present a much more formidable problem to highway

safety than do users of other drugs. The involvement of alcohol in fatal crashes is perhaps as great as ten times the involvement of other drugs. However, it is also a fact that alcohol abuse in conjunction with driving is much more prevalent than is the abuse of other drugs in these situations.

10. CONCLUSIONS BY OTHER REVIEWERS

Similar conclusions have been reached by other reviewers. Miller and Dimling (51) upon reviewing the literature concluded that while drugs most definitely impair the driving task, there is little statistical evidence to prove that the use of drugs actually causes accidents. In addition, Neil (55) has observed that the effects of drugs do not themselves cause accidents and impairment by drugs does not mean that a person will have an accident.

Waller (86) in a 1970 review of the literature concluded that psychoactive drugs are used rather widely and could be expected to impair driving ability on theoretical and pharmacological grounds. In addition, he points out that a large body of anecdotal evidence is available which indicates that drug use in some cases contributes to the occurrence of highway crashes. However, Waller also points out that, "with the possible exception of amphetamine abuse, drug effects are not very marked." Such effects either, "occur when the users are not exposed to the hazards of walking or driving" or that they, "occur seldom enough so that they do not result in a substantial increase in crash experience even among persons who are known to be drug abusers."

Finally, Kibrick and Smart (35) in a recent review concluded that, "psychotropic drug usage is potentially hazardous to drivers" but that, "it is not known whether drivers who need psychotropic drugs would actually be more dangerous on the road without them than with them."

II. RECOMMENDATIONS

On the basis of the information presented in this and other reviews, it is recommended that present emphasis be placed on more adequate research concerning the drug-driving phenomenon and not on more rigorous legislation and enforcement procedures.

RESEARCH RECOMMENDATIONS:

(1) From a research point of view, it will be necessary to develop methods for the detection of hallucinogens in users.

It has already been pointed out that the greatest gap in our research knowledge regards the involvement of hallucinogens in highway crashes. The prime reason for this deficiency is the fact that there are presently no screening methods for the detection of these drugs in the body fluids of users. Some of the problems involved here include the small effective concentration levels of such drugs as well as the rapid metabolism rate of such substances in the body. Hopefully, in the area of highway safety at least, such screening methods, when developed, will be used for research rather than for enforcement purposes until the impact of such drugs has been reasonably assessed.

(2) It will be necessary to develop improved screening methods for the detection of all drugs.

In this case, "improved" refers to a variety of factors such as:

a. Comprehensiveness - It will be advantageous to have a single method (or series of methods) which can be used to screen for all drugs in body fluid samples. Projects implemented in the interest of attaining this goal should be supported (i.e., combined gas chromatography/mass spectrometry/computer assisted techniques).

b. Quantification - Such tests should be capable of indicating how much of a particular drug is present in any sample. This type of information will be necessary in order to accurately relate crash risk to drug use and abuse.

c. Availability - Comprehensive screening facilities must be made available to local toxicologists, coroners and other researchers. In some cases, this may require adequate roadside techniques. In others, accessible centralized facilities (i.e, on a state level), may be acceptable.

(3) More sophisticated research designs must be incorporated into investigations of the drug-driving phenomenon.

It is recognized that some of the research failures and inconsistencies in the past have been the result of inadequate tests for the detection of various drugs. However, it is desirable that future analytical investigations involve more comprehensive sampling procedures and employ consistent criteria for the selection of samples.

With regard to driver record, medical record, and questionnaire surveys, it is necessary that investigators recognize the inadequacies of such data sources and make attempts to utilize data from several sources in order to increase the reliability and validity of their findings.

(4) Research concerning the impact of drugs on traffic safety should be conducted in conjunction with ongoing Alcohol Safety Action Programs.

It is recommended that the ongoing Alcohol Safety Action Program (ASAP) of the National Highway Traffic Safety Administration (NHTSA) be utilized for future drug investigations. Body fluid samples from fatally injured drivers can be obtained in such projects. These samples can then be systematically analyzed for the presence of drugs. The Alcohol Safety Action Program is

capable of providing a very comprehensive sample of the fatally injured driver population obtained from a variety of locations.

A DISCUSSION OF LEGAL COUNTERMEASURES

On the basis of available information more rigorous legal countermeasures are not recommended. More will be said concerning more stringent laws after existing laws have been discussed.

Existing Laws

At the present time every state has some form of law dealing specifically with the use of drugs in conjunction with driving. Such laws are in addition to state and federal laws dealing with drug abuse in general. The Uniform Vehicle Code (see Appendix D) represents an attempt at the national level to standardize the drug-driving laws of the various states by prohibiting driving by any person who is:

- (1) an habitual user of any narcotic drug
- (2) under the influence of any narcotic drug
- (3) under the influence of any drug to a degree which renders him incapable of driving safely

It can be seen from Appendix D, that there is a considerable degree of variation in the extent to which the various states comply with the recommendations of this code. This variation makes the enforcement as well as the effect of such laws difficult to evaluate.

Justification of Drug-Driving Laws

Even more basic than standardization questions, however, is the question of whether or not existing laws are justified by available information. Certainly, there can be no doubt that the use of drugs in some cases contributes to highway crashes. Evidence supporting the assumption that one should not drive while using drugs derives primarily from the known effects of various

drugs, from laboratory studies and from case reports. The degree to which such evidence justifies existing laws necessarily represents a point of view. To the person who is concerned primarily with individual rights and liberties such evidence may be viewed as being minimal or even inadequate. On the other hand, to the person who is relatively more safety-oriented or to whom responsibility for the safety of others has been delegated such evidence may be viewed as being more than adequate to justify existing laws. Certainly, position and responsibility are factors in determining the point of view one accepts. In the latter case, for example, considerably more emphasis will be placed on recognizing a problem before it becomes a major problem.

Thus, we have two divergent points of view concerning whether or not drug-driving laws are justifiable on the basis of available evidence concerning the impact of drugs on highway crashes. In order to obtain an optimal compromise between these two points of view, one might take a utilitarian position and attempt to weigh the negative aspects of such laws (i.e., deprivation of rights, penalization, etc.) against the more positive aspects (i.e., savings of lives, reduction of misery due to injury, etc.). Certainly, such a comparison would be difficult to make even on a subjective level. It is reasonable to assume, however, that present laws prohibiting the use of drugs while driving, are probably resulting in a minimal amount of negative effect in terms of personal restrictions to drivers. Some of the reasons for this assumption include:

- (1) Such laws are difficult to enforce because most drugs are difficult or impossible to detect in users by any practical means.

- (2) Most of the persons who "abuse" drugs are not of the personality disposition to heed such laws.

- (3) There is evidence to indicate that the revocation of a drivers license is not a very effective means of preventing potentially dangerous drivers from using the roads.

In weighing the more positive aspects of drug-driving laws, one would give primary consideration to the potential reduction of drug-induced highway crashes. Would a potential saving of two to five thousand lives per year and a much larger number of serious injuries justify such laws? The answer to this question would certainly be affirmative if such laws were effective in causing such a reduction and if such laws did not seriously detract from more effective countermeasures aimed at the same or a different aspect of the problem.

Effectiveness of Drug-Driving Laws

Unfortunately, it would appear that present drug-driving laws are of minimal effectiveness in directly reducing fatalities and injuries due to highway crashes. The reasons for this minimal effect are the same as the reasons given above for assuming minimal restrictive effects of such laws. Further, drug-driving laws are premature with regard to needed enforcement tools.

However, it is quite probable that laws prohibiting the use of drugs while driving as well as drug "abuse" laws in general have indirectly minimized drug related crashes to some extent by making drug use socially unacceptable. Further, it is reasonable to assume that more liberal laws concerning the use of drugs would result in more frequent use of such substances, thus increasing the exposure of such behavior to highway situations.

A case in point is the social pattern of alcohol use. It has already been established that alcohol is having a much greater impact on highway crashes than are other drugs. However, it should also be pointed out that the use/abuse of alcohol is much more prevalent than is the use/abuse of other drugs. Although factors such as commercialization and advertising are also involved, the legal status of alcohol certainly is an important factor

in the prevalence of alcohol usage as well as in the impact such usage is having on highway crashes.

Detraction From Other Countermeasures

It has been suggested that more rigorous laws concerning drugs and driving are not appropriate at the present time. This is not intended to suggest that the use of drugs in conjunction with driving presents no problem. Nor is this suggestion intended to imply that such behavior is to be condoned. On the contrary, it has already been pointed out that the use of drugs does, in some cases, result in highway crashes. It is also recognized that more extensive legislation and/or enforcement may prevent some of such crashes. However, other factors must be considered in the selection of problem countermeasures.

First of all, it is difficult to justify rigorous "drug-driving" legislation and/or enforcement without valid evidence that such behavior is contributing disproportionately to highway crashes. In view of this question it has already been indicated that adequate evidence of this nature does not exist.

Secondly, the selection and evaluation of countermeasures, legal or other-wise, must be made on a cost-payoff basis. Certainly, any organization is limited to some extent in the amount of resource and energy which it can devote to a particular problem. It is therefore desirable that such resource and energy be invested in countermeasures which are most effective in reducing the problem at hand (i.e. highway crashes). In the area of highway safety, detraction from effective countermeasures can be considered as lives lost. Two factors in the selection of a countermeasure are appropriate at this point.

a. Said countermeasure should be directed at a major contributing factor

of the problem (i.e. alcohol abuse).

b. Said countermeasure should be the most effective of the measures available for reducing the impact of a particular contributing factor (i.e. license revocation or rehabilitation or interlock devices or a combined approach where feasible).

In the case at hand, the problem involves highway crashes and fatalities. Cost-payoff in turn refers to the number of lives saved by a particular countermeasure relative to the lives lost by detracting from or omitting some other countermeasure. Again, available evidence suggests that (1) drug use (other than alcohol) is not a major factor contributing to highway crashes and fatalities; (2) the use of alcohol does appear to be a major contributing factor to highway crashes; (3) much of the reported excess in violations and/or crashes incurred by known drug users is likely to be the result of other factors associated with such persons; and (4) perhaps as many as ninety to ninety-five percent of all fatal crashes do not involve drugs other than alcohol.

Thus, it appears that while existing legal opposition to widespread drug use may be making an indirect contribution by limiting the prevalence of such behavior, more rigorous legislation at this time would appear to be premature. Further, it is suggested that rigorous legal action must be justified by some valid evidence that drug use is making a substantial contribution to highway crashes. Finally, before any attempt is made to increase the emphasis on drug legislation and enforcement, some thought should be given to the possibly detrimental effects arising from a concomitant de-emphasis of alcohol countermeasures.

Dissemination of Information

One of the most basic countermeasures concerning the abuse of drugs

involves the dissemination of accurate factual information. It is important that we do not contaminate such information with sensationalism, emotional over-reactions, and unwarranted assumptions or speculations.

An early approach to the general problem of drug abuse consisted of a "scare-technique" by various federal and social organizations. This technique involved the issuance of essentially non-factual or exaggerated material in an attempt to induce a fear of drugs among youth. Unfortunately, such techniques were not only ineffectual but actually alienated many of the nation's youth who began to doubt the credibility of the source of the material as well as the material itself. As a result, such organizations have recently endeavored to regain some of their lost credibility by providing more factual educational material to the public.

It is highly recommended that we do not make the same mistake with regards to the highway safety aspects of drug abuse. It is evident that the use of most drugs deteriorate the skills and judgement required for safe driving. At the same time, it does not appear that such behavior is having a major impact on highway crashes. Whatever be the reasons for this apparent discrepancy, let us not make the mistake of claiming, as has occurred in the past, that "drugs, not alcohol, are now making the major contribution to highway crashes."

Appendix A
A Drug Use Glossary

(Reproduced from: U.S. Federal Source Book: Answers to the Most Frequently Asked Questions About Drugs U.S. Government Printing Office: 1970 0-376-608)

DRUG USE GLOSSARY

Acid	LSD, LSD-25 (lysergic acid diethylamide)
Acidhead	Frequent user of LSD
Bag	Packet of drugs
Ball	Absorption of stimulants and cocaine via genitalia
Bang	Injection of drugs
Barbs	Barbiturates
Bennies	Benzedrine, an amphetamine
Bindle	Packet of narcotics
Blank	Extremely low-grade narcotics
Blast	Strong effect from a drug
Blue angels	Amythal, a barbiturate
Blue velvet	Paregoric (camphorated tincture of opium) and Pyribenzamine (an antihistamine) mixed and injected
Bombita	Amphetamine injection, sometimes taken with heroin
Bread	Money
Bum trip	Bad experience with psychedelics
Bummer	Bad experience with psychedelics
Busted	Arrested
Buttons	The sections of the peyote cactus
Cap	Capsule
Chipping	Taking narcotics occasionally
Coasting	Under the influence of drugs
Cokie	Cocaine addict
Cold turkey	Sudden withdrawal of narcotics (from the gooseflesh, which resembles the skin of a cold plucked turkey)
Coming down	Recovering from a trip
Connection	Drug supplier
Cop	To obtain heroin
Cop out	Quit, take off, confess, defect, inform
Crash	The effects of stopping the use of amphetamines
Crash pad	Place where the user withdraws from amphetamines
Crystal	Methedrine, an amphetamine
Cubehead	Frequent user of LSD
Cut	Dilute drugs by adding milk sugar or another inert substance
Dealer	Drug supplier
Deck	Packet of narcotics
Dexies	Dexedrine, an amphetamine
Dime bag	\$10 package of narcotics
Dirty	Possessing drugs, liable to arrest if searched
Dollies	Dolophine (also known as methadone), a synthetic narcotic
Doper	Person who uses drugs regularly
Downers	Sedatives, alcohol, tranquilizers, and narcotics
Drop	Swallow a drug
Dummy	Purchase which did not contain narcotics
Dynamite	High-grade heroin

Fix	Injection of narcotics
Flash	The initial feeling after injecting
Flip	Become psychotic
Floating	Under the influence of drugs
Freakout	Bad experience with psychedelics; also a chemical high
Fuzz	The police
Gage	Marihuana
Good trip	Happy experience with psychedelics
Goofballs	Sleeping pills
Grass	Marihuana
H	Heroin
Hard narcotics	Opiates, such as heroin and morphine
Hard stuff	Heroin
Hash	Hashish, the resin of Cannabis
Hay	Marihuana
Head	Person dependent on drugs
Hearts	Dexedrine tablets (from the shape)
Heat	The police
High	Under the influence of drugs
Holding	Having drugs in one's possession
Hooked	Addicted
Hophead	Narcotics addict
Horse	Heroin
Hustle	Activities involved in obtaining money to buy heroin
Hustler	Prostitute
Hype	Narcotics addict
Joint	Marihuana cigarette
Jolly beans	Pep pills
Joy-pop	Inject narcotics irregularly
Junkie	Narcotics addict
Kick the habit	Stop using narcotics (from the withdrawal leg muscle twitches)
Layout	Equipment for injecting drug
Lemonade	Poor heroin
M	Morphine
Mainline	Inject drugs into a vein

O. D.	Overdose of narcotics
On the nod	Sleepy from narcotics
Panic	Shortage of narcotics on the market
Pillhead	Heavy user of pills, barbiturates or amphetamines or both
Pop	Inject drugs
Pot	Marihuana
Pothead	Heavy marihuana user
Purple hearts	Dexamyl, a combination of Dexedrine and Amytal (from the shape and color)
Pusher	Drug peddler
Quill	A matchbook cover for sniffing Methedrine, cocaine, or heroin
Rainbows	Tuinal (Amytal and Seconal), a barbiturate combination in a blue and red capsule
Red devils	Seconal, a barbiturate
Reefer	Marihuana cigarette
Reentry	Return from a trip
Roach	Marihuana butt
Roach holder	Device for holding the butt of a marihuana cigarette
Run	An amphetamine binge
Satch cotton	Cotton used to strain drugs before injection; may be used again if supplies are gone
Scag	Heroin
Score	Make a purchase of drugs
Shooting gallery	Place where addicts inject
Skin popping	Injecting drugs under the skin
Smack	Heroin
Smoke	Wood alcohol
Snorting	Inhaling drugs
Snow	Cocaine
Speed	Methamphetamine
Speedball	An injection of a stimulant and a depressant, originally heroin and cocaine
Speedfreak	Habitual user of speed
Stash	Supply of drugs in a secure place
Stick	Marihuana cigarette
Stoolie	Informer
Strung out	Addicted
Tracks	Scars along veins after many injections
Tripping out	High on psychedelics
Turned on	Under the influence of drugs
Turps	Elixir of Terpin Hydrate with Codeine, a cough syrup
25	LSD (from its original designation, LSD-25)
Uppers	Stimulants, cocaine, and psychedelics

Weed
Works

Marihuana
Equipment for injecting drugs

Yellow jacket
Yen sleep

Nembutal, a barbiturate
A drowsy, restless state during the withdrawal period

Appendix B

A Summary of Research Findings Concerning the Use
of Drugs in Conjunction with Driving

I. EFFECTS OF DRUGS ON USERS

<u>Type of Drug</u>	<u>Physiological Dependence</u>	<u>Psychological Dependence</u>	<u>Expected Effects on Skills and Judgement</u>
<u>Alcohol</u>	yes	yes	deterioration even at low concentrations
<u>Prescription Psychotropes</u>			
sedatives	yes	yes	generally a deterioration
tranquilizers	?	yes	
stimulants	?	yes	
<u>Hallucinogens</u>			
marihuana	no	?	deterioration plus disorientation and hallucinations
other (i.e. LSD, mescaline, etc.)	no	?	
<u>Narcotics</u>			
opiates (i.e. heroin, morphine, opium)	yes	yes	deterioration of skills and judgement as well as of general health
synthetics (i.e. methadone)	yes	yes	
other (i.e. cocaine, etc.)	yes	yes	

II. LABORATORY INVESTIGATIONS CONCERNING THE EFFECTS OF DRUGS ON DRIVING RELATED ACTIVITIES

<u>Reference</u>	<u>Drugs Investigated</u>	<u>Performance Effects</u>
<u>Non-prescription Drugs</u>		
Carter (10)	eleven over-the-counter drugs	no significant effects
<u>Prescription Drugs - Depressants</u>		
Doenicke (20)	<u>Sedative</u> Butabarbital (200mg) plus alcohol	significant deterioration greater deterioration
*Kieholz et.al. (36)	<u>Tranquilizers</u> Chlordiazeporide (20mg) Meprobamate (800mg)	significant deterioration " "
	<u>Sedatives</u> Phenobarbital (200mg) Methylprylon (200mg) Any of the above plus alcohol	" " " " greater deterioration than drug alone

*Study involved simulated driving task

<u>Reference</u>	<u>Drugs Investigated</u>	<u>Performance Effects</u>
*Loomis (42)	<u>Tranquilizers</u> Meprobamate (200mg) " (800mg) Chlorpromazine (25mg)	8% deterioration 16% deterioration 28% deterioration
	<u>Sedatives</u> Secobarbital (25mg) " (50mg) Any of the above plus alcohol (Note: subjects were users of tranquilizers)	no significant deterioration 10% deterioration greater deterioration than drug alone
*Loomis & West (43)	<u>Tranquilizers</u> Chlorpromazine (50mg) Meprobamate (400mg) <u>Sedative</u> Secobarbital (100mg) <u>Analgesic</u> Phenaglycodol (300mg)	significant deterioration " " " " no significant effect
Miller & Uhr (49)	<u>Tranquilizer</u> Meprobamate (800mg) Plus alcohol Alcohol alone	no significant effect " " " significant deterioration
*Smith et.al. (70)	<u>Tranquilizer</u> Benactizine (acute administration) (Note: subjects were psychologically disturbed)	no significant effect some indication of improved performance
Uhr et.al. (81)	<u>Tranquilizers</u> Meprobamate (1600mg) Tranquil (Note: some subjects were psychologically disturbed)	significant deterioration " "

Prescription Drugs - Stimulants

Anonymous (1)	<u>Alcohol and Coffee</u>	coffee did not eliminate deterioration due to alcohol
Muller- Lummroth review (53)	<u>Alcohol and Caffeine</u>	caffeine incapable of neutralizing alcohol may enhance effects
Miller & Uhr (49)	<u>Amphetamine</u>	no significant effect

* Study involved simulated driving task

<u>Reference</u>	<u>Drugs Investigated</u>	<u>Performance Effects</u>
Kraft review (40)	<u>Caffeine and Alcohol</u> <u>Methamphetamine plus</u> <u>alcohol</u>	no significant effect of stimulant in neutralizing effect due to alcohol
Paulus & Mallach (58)	<u>Alcohol and Caffeine</u> (sobriety agent)	no significant effect of stimulant in neutralizing effect due to alcohol

Hallucinogens

Weil et.al. (91)	<u>Marihuana</u>	-inexperienced smokers significantly impaired -experienced smokers less impaired (in some cases enhanced performance)
*Crancer et.al. (13)	<u>Alcohol</u> <u>Marihuana</u>	significant impairment no significant effect

Narcotics

No studies found

III. ESTIMATES CONCERNING THE PREVALENCE OF DRUG USE IN GENERAL AND DRIVING POPULATIONS (Surveys)

<u>Reference</u>	<u>Findings</u>
Manheimer 1968 (47)	-50% adults used <u>some drug</u> at some time -29% adults used <u>some drug</u> in past year -12% Male adults use <u>prescription psychotropes</u> frequently -22% Female adults use <u>prescription psychotropes</u> infrequently
Parry 1968 (57)	-48% adults used <u>psychotropes</u> at some time -25% adults used <u>psychotropes</u> in past year
Smith 1966 (71)	-10-20% drivers use <u>prescribed drugs</u> at any point in time
Smith, Kline, & French 1963 (79)	-10-20% drivers use <u>prescription drugs</u>

* Study involved simulated driving task

IV. DRUG INVOLVEMENT IN FATAL CRASHES (Systematic Analysis)

<u>Reference</u>	<u>% of Samples Involving Drugs</u>	<u>Sample Size</u>	<u>Drugs Investigated</u>
<u>Fatal Single Vehicle</u>			
California 1967 (75)	13% any drug 10% psychotropes	n = 772	prescription and non-prescription
Davis & Fisk 1966 (Florida) (16)	4% any drug	n = 188	prescription and non-prescription
<u>Fatal Multiple Vehicle</u>			
Briglia 1966 (Calif.) (4)	3%	n = 95	barbiturates
U.S. Army 1967 (Europe) (82)	0%	n = 90	prescription and non-prescription
Davis 1968 (Florida) (15)	5.6%	n = 306	barbiturates
Sunshine 1956 (76) Sunshine et.al. (77)	3-4%		barbiturates
Kaye 1970 (Peurto Rico) (33)	7%	n = 180	prescription and non-prescription narcotics
Perrine et.al. (59)	11%	n = 46	prescription and non-prescription

V. DRUG USE AMONG DRINKING POPULATIONS

<u>Reference</u>	<u>Type of Population</u>	<u>% Using Drugs</u>
Finkle (23)	arrested drinking drivers (by questioning and in some cases analysis)	25% any drug 13% psychotropes
Wagner (85)	arrested drinking drivers (by questioning and in some cases analysis)	11%

<u>Reference</u>	<u>Type of Population</u>	<u>% Using Drugs</u>
Chelton & Whisnant (11)	alcoholics	9% by questioning 38% by analysis

VI. USE OF ALCOHOL AMONG KNOWN DRUG USERS

<u>Reference</u>	<u>Type of Population</u>	<u>% Using Alcohol</u>
California (75)	fatal crash victims (with drugs in system)	60% (analysis)
Davis & Fisk (16)	fatal crash victims (with drugs in system)	50% (analysis)
Davis (15)	fatal crash victims (with drugs in system)	50%
Milner (52)	clinical patients	57% males 35% females (medical records)
Smart et.al. (69)	persons dependent on psychotropes	50%

VII. ESTIMATES OF PREVALENCE OF DRUG AND ALCOHOL USE IN CONJUNCTION WITH DRIVING

<u>Reference</u>	<u>Type of Population</u>	<u>% Drink/Drive/Drugs</u>
California (75)	fatal crash victims	9%
Finkle et.al. (24)	arrested drinking drivers	7.2%
Milner (52)	general practice and psychiatric patients	7.1%

VIII. DRIVING RECORDS OF DRUG USERS

<u>Reference</u>	<u>Reported Findings</u>
Crancer & Quiring (14)	(convicted users of prescription drugs, marihuana, and narcotics) -users had 2.5 times as many violations as non-users -users of marihuana and narcotics had 1.3 times as many crashes

Reference

Reported Findings

Crancer &
Quiring (cont'd.)
(14)

-users of prescription drugs had 1.6 times as many crashes as non-users

Klein, Davis, &
Blackbourne
(38)

(users of marihuana)
-users more prone to use of alcohol than non-users
-18% infrequent users and 53% frequent users had been stopped by police while "under the influence"
-frequent users had more license revocations than infrequent users

New York
(92)

(users of narcotics)
-4 times as many crashes and/or violations as the average New York driver

Smart, Schmidt,
& Bateman
(69)

(users of prescription psychotropes)
-2 times as many crashes as expected on basis of age, sex, and driving exposure
-heavy users of amphetamines (alone or with alcohol) contributed most of the excess
-heavy users of (1) alcohol and barbiturates, (2) barbiturates alone, and (3) tranquilizers alone had lower than expected rates

Waller
(88)

(convicted users of prescription psychotropes, hallucinogens, and narcotics)
-1.8 times as many violations as expected on the basis of exposure
-same number of crashes as expected on the basis of exposure

Appendix C
Federal Narcotic and Dangerous Drug Laws

(Reproduced from: Bureau of Narcotics and Dangerous Drugs/U.S. Department of Justice Fact Sheets, U.S. Government Printing Office, 1969, 0-350-436)

Federal Narcotic & Dangerous Drug Laws

The history of drug abuse in this country has prompted passage of two sets of Federal laws controlling the drugs of abuse. The earlier set regulates the use of "narcotic drugs," and marihuana, while the second and more recent set, controls the use of the "dangerous drugs."

Federal Narcotic and Marihuana Laws

The term "narcotic drugs," includes opium and its derivatives such as heroin and morphine; coca leaves and its derivatives, principally cocaine; and the "opiates" which are specially defined synthetic narcotic drugs. Four principal statutes--the Narcotic Drugs Import and Export Act, the Harrison Narcotic Act, the Narcotics Manufacturing Act of 1960 and the Marihuana Tax Act--control narcotic drugs and marihuana. These laws are designed to insure an adequate supply of narcotics for medical and scientific needs, while at the same time they are planned to curb, if not prevent, the abuse of narcotic drugs and marihuana. In addition to these laws, there are other Federal legislative measures to lend additional control over narcotic drugs. Since, however, they are designed primarily to aid enforcement of the major statutes, they are not discussed here.

The Narcotic Drugs Import and Export Act authorizes the import of crude opium and coca leaves for medical and scientific needs in the United States. Import of other narcotic drugs is prohibited. Manufactured drugs and preparations may be exported under a rigid system of controls to assure that the drugs are used for medical needs only in the country of destination.

The Harrison Narcotic Act sets up the machinery for distribution of narcotic drugs within the country. Under the law, all persons who import,

manufacture, produce, compound, sell, deal in, dispense or transfer narcotic drugs must be registered and pay a graduated occupational tax. The law also imposes a commodity tax upon narcotic drugs produced in or imported into the United States and sold or removed for consumption or sale.

Under the Harrison Act, sales or transfers of narcotic drugs must be recorded on official order forms. However, the transfer of narcotic drugs from a qualified practitioner to his patient and the sale of these drugs by a pharmacist to a patient with a lawfully written doctor's prescription are exceptions to this requirement.

The Narcotics Manufacturing Act of 1960 developed a system of licensing manufacturers to produce narcotic drugs. It also provided a method to set manufacturing quotas for the basic classes of narcotic drugs, both natural and synthetic, insuring that an adequate supply of each drug will be available for medicine and science.

The Marihuana Tax Act requires all persons who import, manufacture, produce, compound, sell, deal in, dispense, prescribe, administer, or give away marihuana to register and pay a graduated occupational tax. No commodity tax is imposed on this drug. However, a tax is imposed upon all transfers of marihuana at the rate of \$1 per ounce, or fraction of an ounce, if the transfer is made to a taxpayer registered under the Act.

Penalty Provisions for the illegal sale or illegal importation of all narcotic drugs and marihuana can mean a sentence of 5 to 20 years in prison and the possibility of a \$20,000 fine. A second or subsequent offense receives a penalty of 10 to 40 years in prison with a possible \$20,000 fine. There can

be no probation or suspension of these sentences.

The penalties for all so-called possession type of offenses range between 2 and 10 years in prison for the first offense and between 5 and 20 years for the second offense. For a third or subsequent offense, the penalties can be from 10 to 40 years in prison. There can be no probation or suspension of sentence for a second or subsequent offense.

Because of the serious nature of narcotic addiction among young persons, the law establishes special penalties for the sale of narcotic drugs to a minor. The penalties for unlawful sale of heroin to a minor by an adult are not less than 10 years in prison or a life sentence or death if the jury so directs. A penalty of 10 to 40 years in prison is levied when marihuana or other narcotic drugs are sold to a minor.

In 1966 special legislation was enacted to allow those violators who are narcotic addicts to return to useful, productive lives. The Narcotic Addict Rehabilitation Act provides: (1) Civil commitment of certain addicts in lieu of prosecution for Federal offenses; (2) Sentencing of addicts to commitment for treatment after conviction of Federal offenses; (3) Civil commitment of persons not charged with any criminal offense; (4) Rehabilitation and post-hospitalization care programs and assistance to states and localities; and (5) Availability of parole to all marihuana violators presently incarcerated or subsequently convicted under Federal law.

All states have either adopted the Uniform Narcotic Act recommended in 1937 for the specific purpose of making all state narcotic laws analogous, or modified it to fulfill the state's individual needs. Similar to the Federal laws, state laws regulate legitimate traffic to qualified manufacturers,

wholesalers, druggists, practitioners and researchers.

Federal Dangerous Drug Laws

Three groups of dangerous drugs--depressants, stimulants, and hallucinogens--are controlled by the Drug Abuse Control Amendments to the Federal Food, Drug, and Cosmetic Act passed in 1965 and amended in 1968.

Drug Abuse Control Amendments control drug abuse in two ways. One, they provide for stronger regulations in the manufacture, distribution, delivery, and possession. Two, they provide strong criminal penalties against persons who deal in these drugs illegally.

Thus, all registered manufacturers, processors and their suppliers, wholesale druggists, pharmacies, hospitals, clinics, public health agencies, and research laboratories must take inventories, keep accurate records of receipts and sales of these drugs and make their records available to the Bureau of Narcotics and Dangerous Drugs agents for examination. No prescription for a controlled drug older than six months can be filled nor can refills be made more than five times in the six-month period.

Penalty Provisions for illegal possession of dangerous drugs can mean a maximum sentence of one year in prison or a \$1,000 fine, or both. However, the offender may be placed on probation for a first offense. If he meets the condition of his probation, the court may set aside his conviction. A second offense allows for probation, but does not allow for the conviction to be set aside. The third offense calls for a maximum prison term of three years or a fine of \$10,000, or both.

A person who illegally produces, counterfeits, sells, manufactures or possesses dangerous drugs with intent to sell, may receive a maximum penalty of not more than five years in prison or a \$10,000 fine, or both.

Because of the serious consequence of drug abuse among young people, special penalties are provided for those over eighteen years of age who sell or give any of the controlled drugs to persons under the age of 21. The first offense carries a maximum penalty of 10 years in prison, or a fine of \$15,000, or both; a second offense increases the maximum prison term to 15 years, or a fine of not more than \$20,000, or both.

Many states have adopted legislation for dangerous drugs similar to the controls at the Federal level.

Appendix D
Uniform Vehicle Code and Corresponding State Laws

(Adapted from: Uniform Vehicle Code: Rules of the Road with Statutory Annotations; National Committee on Uniform Traffic Laws and Ordinances (UVCA), Washington, D. C.; 1968, supplement 1970.
and from: Suspension and Revocation of Drivers' Licenses; Highway Users Federation for Safety and Mobility, Washington, D. C.; revised edition 1970.)

Uniform Vehicle Code

Section 11-902.1 -- Persons Under the Influence of Drugs

It is unlawful and punishable as provided in section 11-902.2 for any person who is an habitual user of or under the influence of any narcotic drug or who is under the influence of any other drug to a degree which renders him incapable of safely driving a vehicle to drive a vehicle within this state. The fact that any person charged with a violation of this section is or has been entitled to use such drug under the laws of this state shall not constitute a defense against any charge of violating this section.

Annotation

UVC section 11-902.1 is based on the principle that no person should drive when he is incapable of driving safely because of the use of drugs, regardless of the nature or amount. It prohibits driving by any person who is:

- I. An habitual user of any narcotic drug.
- II. Under the influence of any narcotic drug.
- III. Under the influence of any other drug to a degree which renders him incapable of driving safely.

Since a prescription drug, or any drug legally obtained, has the same impairment potential as if used illegally, the Code further provides that:

- IV. The legal use of a drug shall not constitute a defense to any charge of driving while under its influence.

The following summary compares state laws on each of these four principles, and additionally notes laws that expressly prohibit driving while under the combined influence of alcohol and drugs. From the summary table on page 93 it can be seen that:

(1) Twenty-eight states have laws which comply with provision I of the Code in that they prohibit driving by any habitual user of narcotics.

(2) Forty-two states have laws which comply with provision II of the Code in that they prohibit driving while under the influence of narcotic drugs. Seven additional states are also in compliance with this provision of the Code as they prohibit driving while under the influence of any drug.

(3) A total of twenty-nine states are in substantial conformity with provision III of the Code in that they prohibit driving while under the influence of any drug or under the influence of any drug to a degree which renders him incapable of driving safely. An additional sixteen states are in varying degrees of conformity as they prohibit driving while under the influence of specific types or categories of drugs.

(4) Twenty states specify that legal drug use should not constitute a defense to a charge of driving while under the influence of drugs. Iowa has a law prohibiting driving while under the influence of certain drugs prescribed by a doctor.

(5) Seven states have laws which prohibit driving while under the combined influence of alcohol and other drugs.

Note: For additional information see pp. 505-513 of the UVCA)

Section 11-902.2 -- Penalties and Administrative Action of Commissioner

(a) Every person who is convicted of a violation of ... section 11-902.1 shall be punished by imprisonment for not less than 10 days nor more than 1 year, or by fine not less than \$100 nor more than \$1000, or by both such fine and imprisonment. On a second or subsequent conviction under either section he shall be punished by imprisonment for not less than 90 days nor more than 1 year, and, in the discretion of the court, a fine of not more than \$1000.

(b) The commissioner shall revoke the license or permit to drive and any nonresident operating privilege of any person convicted under ... section 11-902.1.

SUMMARY TABLE OF STATE LAWS DEALING WITH THE USE OF DRUGS AND DRIVING

STATE	STATE LAW REFERS TO:				
	I Users of Narcotics	II Infl. of Narcotics	III Infl. of Other Drugs	IV Legal Defense	V Combined Use
Alabama	X*				
Alaska		X*			
Arizona	X	X*	X	X	
Arkansas	X	X*	X	X	
California		X*	X*	X	X
Colorado	X*	X*	X*	X	
Conneticut		A*	X*		X
Delaware		A*	X*		X
Florida	X	X*	S		
Georgia	X	X*	X*	X	
Hawaii		A*	X	X	
Idaho	X*	X*	X	X	
Illinois	X	X*	X	X	
Indiana		X*	S*		
Iowa		X*	X*	X	X
Kansas	X	X*	X*	X	
Kentucky		X*	X		
Louisiana		X*	S*		
Maine		A*	X*		X
Maryland	X	X*			
Massachusetts		X*	S*		X
Michigan	X	X*	S*		
Minnesota	X	X*			
Mississippi	X	X*	S		
Missouri	X	X*	X	X	
Montana	X	X*	X*	X	
Nebraska		A*	X*		
Nevada	X	X*	X*	X	
New Hampshire		X*	S*		
New Jersey		X*	S*		
New Mexico	X	X*	X*	X	
New York		A	S		
North Carolina	X	X*			
North Dakota	X	X*	S*		
Ohio		X*	S		
Oklahoma	X	X*	X*	X	
Oregon		X*	X*		
Pennsylvania		X*	S*		
Rhode Island	X	X*	S*		
South Carolina	X	X*	X*		
South Dakota	X	X*	X*		
Tennessee		X*	S*	X	
Texas		X*	X	X	
Utah	X	X*	X	X	
Vermont		A*	X*		
Virginia		X*	S*		
Washington	X*	X*	X*	X	
West Virginia	X	X*	X*	X	
Wisconsin	X	X*	S*		
Wyoming	X	X*	X*	X	
District of Columbia		X*			

S- State cites specific drugs
A- State prohibits driving while under the influence of any drug

Note: An X in column III signifies that a particular state either has a law prohibiting driving while under the influence of any drug or a law prohibiting driving while under the influence of any drug to a degree which renders him incapable of driving safely.

*License revocation provisions (Infor. concerning habitual users of narcotics is incomplete)

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